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Castings Are Used To Lift Heavy Loads

CITY authorities had decreed that the buildings on entire city block had to be moved back 20 feet to permit the widening of a street. The job had to be completed in six weeks. On the afternoon of the last day of the specified time, traffic was tied up at both ends of the block and a solitary

Castings Are Used in the Construction of High Grade Jacks

man with a whistle stood in the middle of the street. Short blasts at regularly timed intervals and the group of buildings was seen to move ever so slightly. Finally the job was done one-half hour before the contracted finishing time. Moving a whole city block 20 feet from its original location is not a small job. Tools of various descriptions are needed for that type work. One of the most important is the jack. Jacks are made in various sizes and types. One of the most important types is the railroad jack used principally in construction, surfacing, repairing and ballasting work. Another important type is the journal jack, which is designed for lifting and adjusting low-set loads, tanks and structural material. Castings play an important part in the manufacture of jacks, being used especially in the base and frame to provide the required strength with minimum weight.

Find Where Castings Can Be Sold

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CLEANLINESS IS PRIDE

Gray Iron Foundry

AN OLD axiom referring to cleanliness, which frequently is used in admonishing the younger generation, pertinently has been paraphrased for use in modern industrial life as follows: *Cleanliness and Neatness Spell Efficiency, and Efficiency Means Profit.* Perhaps the most striking illustrations of the principles of cleanliness carried out to a high degree are found in advertisements depicting food packing in progressive establishments where immaculate walls glisten with white tile or paint and the operators are clad in white uniforms with caps to match.

While some of the more skeptical may point out that rigid observance of the precept of cleanliness in food packing establishments is due to stringent federal pure food laws regarding the handling of foods for human consumption, rather than to altruistic motives, the fact remains that the principles of neatness and cleanliness are playing an important part in modern industry. Although the principles cannot be carried out to quite the high degree as illustrated previously, a tour through any progressive machine shop or manufacturing plant will reveal clearly that there is a place for everything and everything is in its place. Dirt is conspicuous by its absence.

Of course, it also must be pointed out that the terms cleanliness and neatness must be considered in the light of the field under discussion, because a neat, clean machine shop hardly will meet the requirements for a food packing plant, and a neat, clean foundry will not fulfill the specifications for a machine shop. While many well meaning persons will say that it is absurd

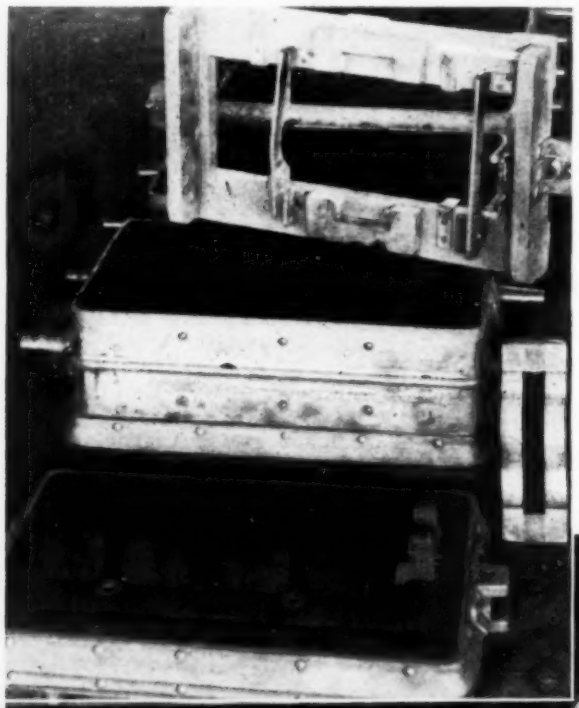


Fig. 1 (Upper Left)—Drag Mold for Cylinder Head Without Jacket Core in Place. Fig. 2—Cope, Drag and Matchplate for Hot-spot Manifold Casting

# of an Ohio

BY EDWIN BREMER

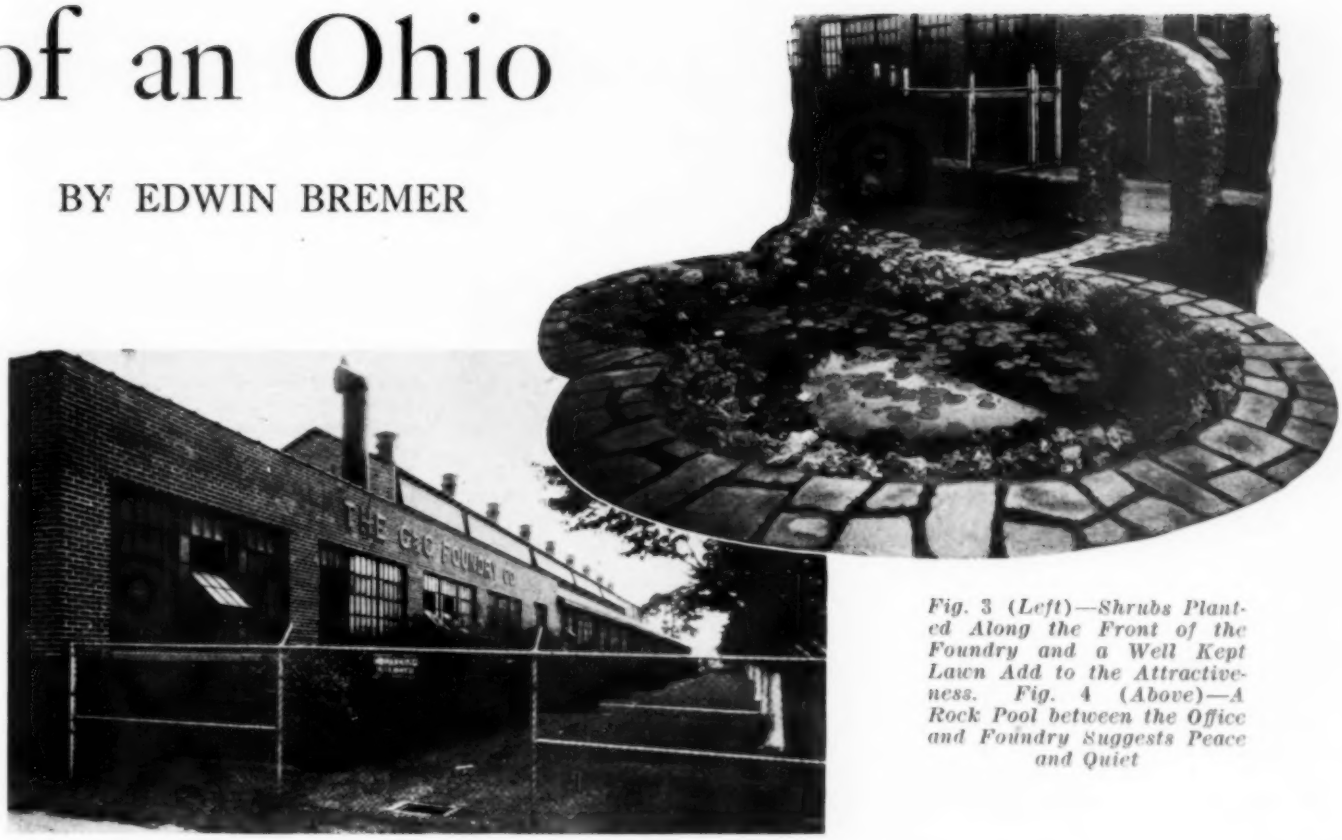


Fig. 3 (Left)—Shrubs Planted Along the Front of the Foundry and a Well Kept Lawn Add to the Attractiveness. Fig. 4 (Above)—A Rock Pool between the Office and Foundry Suggests Peace and Quiet

to try to apply the terms neat and clean to a foundry, because the operations involve the employment of sand which to them is nothing more nor less than dirt, a visit to a number of foundries in different parts of the country soon would convince them that a foundry can be neat and clean.

One specific example of such a foundry is the G. & C. Foundry Co., Sandusky, O. Not only has the firm endeavored to maintain attractive conditions within the foundry, but also, as may be observed from Figs. 3 and 4, considerable effort has been made to provide an attractive exterior appearance. While in many foundries raw materials, flasks and other foundry equipment not in use are dumped indiscriminately around the yard, the G. & C. Foundry has provided definite locations for those materials.

Core sand and molding sand are stored under cover in two buildings each 25 x 100 feet. Another smaller building is used for storing flasks and other foundry equipment which are not in use. Pig iron, steel scrap and cast scrap are unloaded into open bins along a spur track. Since the bins are close to the foundry, and there is a tendency for small pieces of metal to break off and fly during the unloading of pig iron, etc., means are provided to protect the workers and the foundry windows. That consists of a coarse mesh screen suspended from a monorail track which is located along the edge of the bins on the foundry side.

The foundry building is 84 x 300 feet. The core room on one end is 84 feet square and the cleaning and shipping room on the other end is 100 feet square. In addition to those departments a pattern storage room is located in the rear of the office building and a small machine shop is adjacent to the cleaning and shipping

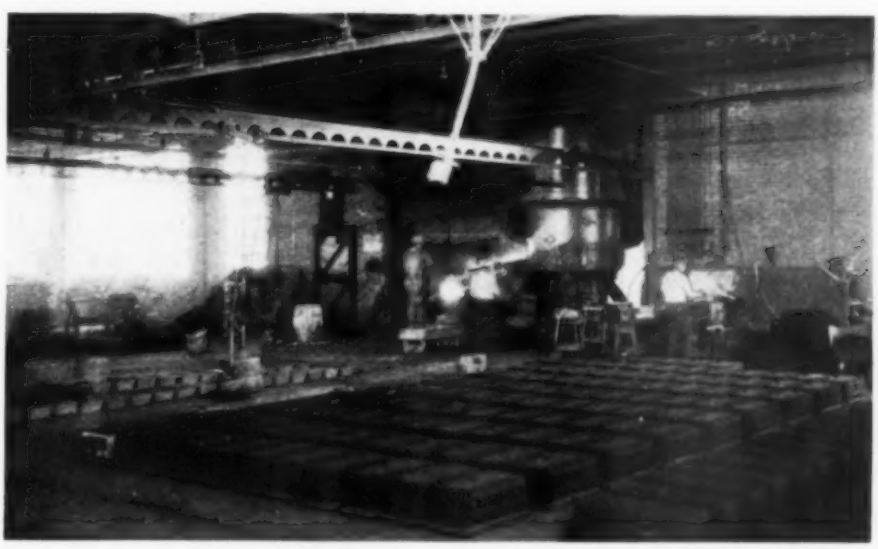


Fig. 5—A View of One of the Floors and the Cupola Located in a Wing Attached to the Center of the Foundry

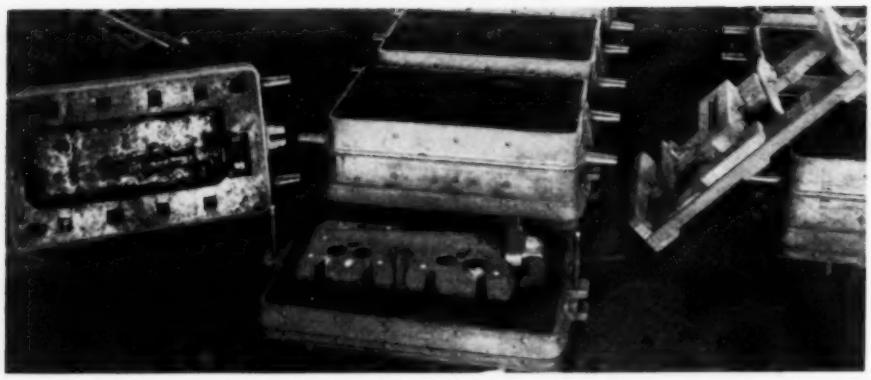


Fig. 6—The Cope and Drag with the Water Jacket Core in Place. The Template for Locating the Core Is at the Right

department. In the core room, shown in Fig. 9, cores are made by hand and on three core blowing machines supplied by Wm. Demmler Bros., Kewanee, Ill.

Cores are baked in an 8-section, shelf-type, gas-fired oven supplied by the Swartwout oven division, Foundry Equipment Co., Cleveland, or in two large, car-type ovens. The shelf-type ovens are for small cores which are placed in one side and removed from the other side after baking. Large cores are baked overnight in the large ovens. Electric pyrometers on all ovens indicate the temperatures at all times. A steel rack, suspended from a monorail, transports the cores from the core room into the foundry.

Foundry Is Clean

While as a general rule it is not so difficult to keep the core room, inspection department and shipping department clean, many believe that the task of keeping a foundry clean would be a Herculean feat. However, that the maintenance of a clean foundry is an accomplished fact, is illustrated amply by the G. & C. foundry. Perhaps, one of the greatest incentives in promoting that condition is the interest displayed by the management in cleanliness of the plant, and in seeing that facilities are provided for storing equipment not in use. Psychologists have pointed out that working conditions have considerable effect upon the attitude of the workman toward his work. The management has realized that fact, believing that a clean plant not only gives the workmen more cheerful surroundings, but also aids in the production of better castings.

However, the present state of cleanliness in the foundry was not like Topsy that jes' growed, but is the result of an educational campaign and in some instances of the application of drastic measures. For example, one molder had the habit of throwing the tramp iron, etc. found in his sand pile, back against the foundry wall. He soon became cured when he discovered a miscellaneous collection of foundry weights, etc. which purposely were placed in his sand pile. This material was revealed when he struck it with the shovel Now, the men exert an effort to keep the foundry in presentable condition at all times.

Fig. 5 shows a view of one of the floors near the cupola. The foundry contains 48 floors on either side of a wide central gangway extending the length of the shop. The gangway is about 12 feet wide and is of concrete. Molds are made by hand and on molding machines supplied by the Osborn Mfg. Co., Cleveland, and by the International Molding Machine Co., Chicago. About 40 of the floors are devoted to machine work and the remainder to bench work. Molding sand is cut over and tempered by a night crew with a portable sand cutter supplied by the American Foundry Equipment Co., Mishawaka, Ind. At certain intervals the sand on each floor is screened through a vibrating screen supplied by the Deister Concentrator Co., Fort Wayne, Ind.

Metal is melted in a cupola lined to 66 inches, supplied by the Whiting Corp., Harvey, Ill. As shown in Fig. 5, the cupola is located in a two-story addition or extension on one side and at the center of the foundry building. The upper floor of the addition forms the charging floor for the cupola, and it is large enough to store all the metal charges and coke for the day's heat. A large elevator transports trucks, each containing a metal charge, from the ground to the charging floor. Metal charges are composed of pig iron, steel scrap, and cast scrap. Each charge weighs 2000 pounds and coke splits weighing 200 pounds are placed between the iron charges. Air for the cupola is supplied by a blower made by the B. F. Sturtevant Co., Boston, Mass., and located in a separate room adjoining the cupola building. Volume of blast supplied to the cupola is approximately 8500 cubic feet per minute as measured by a device supplied by the Chas. J. Clark Blast Meter Co., Gladbrook, Iowa. An elaborate monorail or tramrail system built by the Cleveland tramrail division, Cleveland Crane & Engineering Co., Wickliffe, O., conveys the molten metal from the cupola to the various molding floors.

Accurate Alignment Necessary

After the castings are shaken out, they are transported to the cleaning department. The castings are cleaned in tumbling barrels or in sandblast equipment supplied by the New Haven Sand Blast Co., New Haven, Conn. Following the cleaning, the castings are ground on double stand grinders manufactured by the U. S. Electric Tool Co., Cincinnati; Safety Grinding Wheel & Machinery Co., Springfield, O., and the Marschke Mfg. Co., Towson, Md.

The major portion of the castings

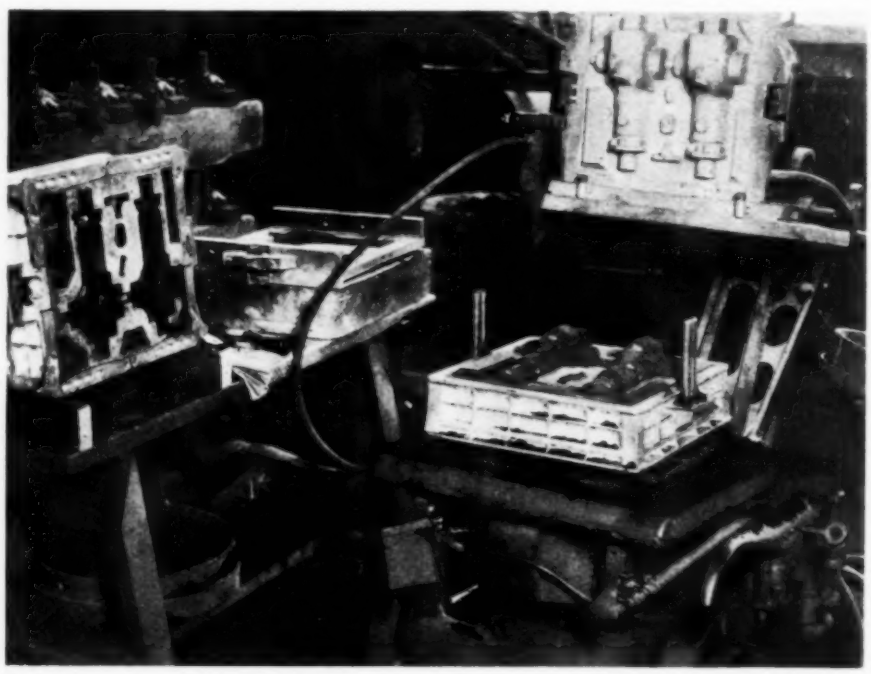


Fig. 7—Cope, Drag and Matchplate for Compressor Cylinders for Refrigeration Unit Castings

produced by the G. & C. Foundry Co., are for automobiles and electric refrigerator units. Since these parts have to be produced in quantity with a minimum tolerance allowed for variation from the specified dimensions, considerable care must be exerted in making the molds, setting the cores, etc. As methods of molding always are of interest, manufacture of molds for several types of castings will be described.

Core Located by Template

Fig. 1 shows the drag mold for an automobile cylinder head which is made on a jolt-squeeze machine. As may be noted, the drag contains 5 ram-up cores consisting of 4 small circular cores, which serve to locate and support the water jacket core and a fifth core which forms a support for the water inlet. Fig. 6 shows the jacket core in place, the cope mold, and the template used for locating the jacket core in position. The template consists of a wooden frame with adjustable pin lugs on the two ends, a central, removable wooden block, and two hinged pieces of metal that can be swung up out of the way. In placing the jacket core in position, pins are set in the flask lugs, and the template with the wooden block removed and the hinged pieces thrown back is lowered onto the flask. The core which has the same dimensions of the opening in the template, then is placed in position. The central wooden block whose underside conforms to the shape of the core, is put on and pushed down until it is seated. The same procedure is followed with the hinged pieces, which are near the ends of the core. Through those operations the core is located as to length, breadth and height.

The template is removed and the molder places 8 tins in as many depressions on the core. The tins prevent piercing of the core by the chaplets which are placed in the cope mold. While the views of the mold show two runners on either side of the drag, at present only one is used. The runner feeds metal to four branch gates cut in the cope. As may be observed, the metal from the runner rises into small buttons about 1 x 1 x 1-inch before passing into the branch gates. A strainer core about 1½ x 2 inches and containing 10 holes, is placed over one end of the runner immediately beneath the sprue. The riser is placed at the other end. Two men, operating drag and cope molding machines, put up 150 molds a day and set the cores.

Fig. 7 shows the cope, drag and matchplate for producing cylinder blocks for electric refrigerating units. The castings are made two-up in a 14 x 16-inch taper flask with a 5-inch drag and a 7-inch cope. They are produced on a jolt-squeeze machine at the rate of 125 molds per day. To prevent shifting of the cope in relation to the drag when the flasks are removed, raised portions are left on the face of the drag and corresponding depressions in the cope. These are located near the four corners of the molds. The mold cavity is filled with molten metal through a central sprue which is located over a strainer core in the drag.

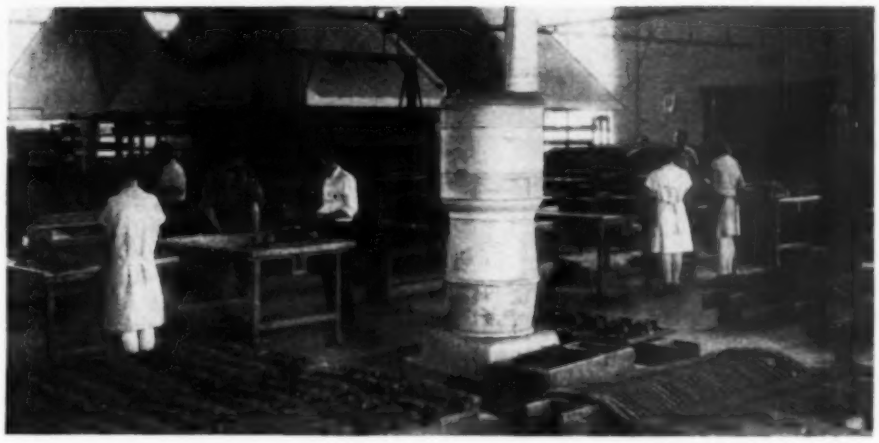


Fig. 9—The Core Room of the Foundry Is Kept Spick-and-Span

Cavity Formed in Drag

Heavy flywheels for refrigerating units which have a peculiar design and weighing 17½ pounds each are made two-up without shrink bobs as shown in Fig. 8. Snap flasks 13 x 26 inches with a 3½-inch drag and a 5-inch cope are used. The molds are produced from a matchplate on a jolt-squeeze machine at the rate of 180 molds per day. As may be observed, the pattern is parted so that the cavity is formed completely in the drag. Shifting of the cope in relation to the drag is prevented by the method of establishing the parting line. Instead of the parting line being level across the face of the drag, the sand is cut away at the edges which allows the sand in the center to project above the parting line at the flask edges. A reverse contour in the cope allows the sand at the edges to project below the parting line in the central portion. The mold cavities are fed through a central sprue which is located in the center of a short rectangular runner. The ends of the runner, located in the cope, supply metal to the four branch gates through small strainer cores. A riser of about the same diameter as the sprue is taken off one of the gates.

One job which shows what ingenuity can accomplish in promoting ease of production is that of making what is popularly known among the automobile fraternity as the hot-spot manifold. The cope, drag and plate are shown in Fig. 2. The hot-spot manifold forms a vapor-tight chamber around part of the exhaust manifold. The gasoline from the carburetor passes into that chamber

Fig. 8—Flywheels Weighing 17½ Pounds Each Are Made Two-up in a Flask

and is said to be highly vaporized and mixed before entering the cylinders of the automobile. As may be expected the metal section of the casting is as light as possible throughout, and the various cores that form the hollow portions of the castings have small dimensional tolerances. Also the cores must be located accurately in the mold to prevent shifting and cutting through the walls of the casting.

The molds are made on the bench using special snap flasks 11 x 30 inches which are raised on one side in the drag, and cut away at the same point in the cope. One molder produces from 90 to 100 molds per day setting his own cores. The drag

Fig. 10—Stock in the Shipping Room Is Placed in a Number of Bins

flask, not including the raised side, is 4 inches high and the cope is 8½ inches high. Two ram-up cores are placed in the drag which support the other cores forming the hollow portions of the casting. While not shown clearly in the illustration, the small core in the center forms the vaporizing chamber which surrounds the manifold carrying away the exhaust gases. One ram-up core is placed in the cope. That core contains a small hole into which the projection on the small chamber core fits.

The mold cavity is fed from 8 branch gates supplied with molten metal through a sprue by two longitudinal runners. As in the cases mentioned previously, a strainer core is placed below the sprue in the manifold mold. Gates are cut at six point near the ends of the cylindrical cores and at two points where the sloping portion of the longest tubular section becomes horizontal. Two risers are placed on the opposite sides to the latter two gates.

Sidney J. Cook has been elected vice president of Egan, Webster & Co. Inc., Pittsburgh. Mr. Cook has been associated with the purchasing department of the Youngstown Sheet & Tube Co., Youngstown, O., for 20 years.

Grubb Talks to Chicago Foundrymen's Club

Chicago Foundrymen's club opened its 1930-31 series of winter lectures with an address on Oct. 2, by A. A. Grubb, Columbus, O., who discussed sand control. Mr. Grubb explained advanced methods in testing and controlling sands with respect to grain size. He showed the relationship of fineness to such qualities as green and dry bonding strength, permeability, chemical content and resistance to heat. He pointed out that the newer methods of analyzing grain sizes of foundry sand enable a more intelligent approach to sand control and its reclamation. He emphasized the importance of proper sand control not only in the foundry but at the source on the part of the producer of foundry sands. R. E. Turnbull, Arcade Mfg. Co., Freeport, Ill., told of his recent trip abroad and his visits to European foundries.

Book Review

The Constitution of Steel and Cast Iron, by Frank T. Sisco, cloth, 332 pages, 6 x 9 inches, published by the American Society for Steel Treating, Cleveland, and supplied by THE FOUNDRY, Cleveland, for $3.00, and in London by the Penton Publishing Co., Ltd., 416-17 Caxton House, Westminster, for 15s, postage extra.

During the four-year period from 1926 to 1930 a series of 24 articles discussing the theory underlying the constitution and heat treatment of steel and cast iron were presented in the *Transactions* of the American Society for Steel Treating by the author, and these now have been arranged in book form. The book is divided into two distinct parts of which the first discusses the constitution of steel and cast iron and the second heat treatment. Part I contains ten chapters of which the first four deal with fundamental principles, equilibrium diagram, constitution of binary alloys, constitution and structure of hypoeutectoid and eutectoid steels. Chapter V is on constitution and structure of hypereutectoid steels and is followed by chapters on effect of other elements on structure and properties, constitution of hypoeutectic cast irons, eutectic and hypereutectic cast irons, gray cast iron, and effect of other elements on structure and properties of cast iron.

Part II deals with theory of heat treatment, annealing, normalizing, spheroidizing, theory of hardening, hardening of steel in the first six chapters. Structure of sorbite, troostite and martensite is discussed in Chapter VII. This is followed by chapters on tempering of hardened steel, theory of hardening steel, case carburization, heat treatment of carburized steel, principles of cold working, heat treatment of cold-worked steel, and the structure of alloy steels.

Quad-City Group Meets

The regular monthly meeting of the Quad-City Foundrymen's association was held at the LeClaire hotel, Moline, Ill., Oct. 20. Harry Dietert, research engineer, United States Radiator Corp., Detroit, addressed the meeting on "Gating Castings." He stressed the importance of gating in the production of castings of high quality and said that foundrymen should aim to produce castings of high quality rather than to make them just good enough to be passed by inspectors.

The speaker described the manner in which the U. S. Radiator Corp. had obtained data from which the mathematical curves presented were plotted. He emphasized the fact that the figures quoted were applicable only to castings having a metal thickness of 1/8 to 3/8 inches, for a definite iron mixture poured at a given temperature. That a definite relationship existed between those three quantities and the size of the gate was made clear by the speaker, both in his talk and later in the discussion.

Mr. Dietert also told of the work conducted by others and explained that the entirely different results obtained were due to different conditions. However, he said that a definite practice could be evolved for each shop, or each class of work. The speaker used latern slides to show the importance of accurate temperature control.

Discussion brought out the need for a standard nomenclature for gating. Mr. Dietert told the group that the A. F. A. committee on gating was attacking that phase of the problem first and that it was an important issue for the development of the science of gating. Considerable interest was evinced at the meeting which was attended by 110 foundrymen of the district.

Selects Chicago for 1931

A.F.A. Will Hold Convention With Limited Exhibit in Stevens Hotel Week of May 4, 1931—Pick Philadelphia for 1932

THE 1931 convention and exhibition of the American Foundrymen's association will be held in the Stevens hotel, Chicago, the week of May 4, 1931, according to a recent announcement of the A. F. A. This announcement follows the unanimous vote of a special committee appointed to consider the question, in a meeting held at the Hotel Statler, Buffalo, Oct. 17.

The committee was unanimous in its opinion that, all things considered, the accommodations available at the Stevens hotel were superior for this meeting to those offered by other cities whose invitations were presented. The proposal of the Stevens hotel includes a 50 per cent increase in exhibit space over that used for the A. F. A. convention in 1929, and two additional meetings rooms in the hotel tower, seating 200 and 300 persons, respectively.

As announced at the meeting by Chairman N. K. B. Patch, Lumen Bearing Co., Buffalo, and president of A. F. A., a limited exhibit of foundry equipment and supplies is scheduled for the 1931 meeting, following the policy established in 1929. The committee also was unanimous in feeling that it is essential to the success of conventions with limited exhibits that all activiies of convention week be housed in one building.

Coupled with the decision of the special committee to meet in Chicago next year was the recommendation that the 1932 annual meeting be held in Philadelphia and that an option be secured on the new Philadelphia convention hall, now under construction, for a convention and large exhibit the first full week in May, 1932. It was further recommended by the committee that, in the future, all annual meetings of the American Foundrymen's association be scheduled for the first full week in May.

In addition to President Patch, and Vice President E. H. Ballard of the General Electric Co., West Lynn, Mass., the following members of the special committee attended the meeting: L. L. Anthes, Anthes Foundry Ltd., Toronto; B. H. Johnson, R. D. Wood & Co., Philadelphia; Frank J. Lanahan, Fort Pitt Malleable Iron Co., Pittsburgh; H. W. Standart, Northern Engineering Works, Detroit; S. W. Utley, Detroit Steel Casting Co., Detroit; S. C. Vessy, W. W. Sly Mfg. Co., Cleveland; Executive Secretary C. E. Hoyt, Chicago, member ex-officio.

In preparation for the coming Chicago convention, the various subcommittees of the program and papers' committee all report that a full schedule of sessions, shop-operation courses, and round-table luncheon meetings are being scheduled. In addition, the papers on new foundry developments promise one of the most interesting conventions ever held for foundrymen in all branches of the industry.

To the shop operation courses on steel, gray iron and nonferrous shop practice held in the past, two more courses will be added in 1931, covering malleable foundry practice and sand control. It has become evident that these courses, organized particularly for the purpose of giving practical instruction in shop practice fundamentals, fill a distinct need, and the schedule for 1931 will be arranged more carefully and thoroughly than ever before.

Personnels of the gray iron and malleable shop-operation committees already have been selected, and the nonferrous, steel and sand control committees are being organized rapidly. Members of the malleable and gray iron groups are as follows:

MALLEABLE

J. B. Deisher, *Chairman*, Columbia Malleable Castings Corp., Columbia, Pa.

August Van Lantschoot, Iowa Malleable Iron Co., Fairfield, Iowa.

Walter Ranis, Union Malleable Iron Co., East Moline, Ill.

A. M. Fulton, Northern Malleable Iron Co., St. Paul.

GRAY IRON

Max Kuniansky, *Chairman*, Lynchburg Foundry Co., Radford, Va.

Dr. R. Moldenke, Watchung, N. J.

C. J. Scullin, Mississippi Valley Research Laboratories, St. Louis.

The general sessions and round-table luncheon meetings will complete the program which will start on Monday afternoon of convention week, continuing through Thursday. As at the Cleveland meeting last May, three round-table groups will be held to consider malleable, steel and nonferrous founding problems.

Hotel Stevens and the Skyline Looking North on Michigan Boulevard

GRAY IRON

Possesses

Valuable Engineering Properties

Part X

NEARLY everyone has some conception of the properties of hardness, but no one has defined the term accurately. To the foundryman and engineer the term hardness may bring to mind good wear resistance, while to the production man it instantly conjures up the vision of difficult machining. Both machining and wear resistance are comparative terms, and the term hardness is in the same category. Hardness sometimes is defined as resistance to permanent deformation. Hardness may indicate abrasive resistance of various types, resistance to indentation through either slow or rapid application of load, resistance to being cut by other metals or conversely, ability to cut, etc. Since hardness is a general term it is not surprising to find that there is no universal standard test for its mensuration.

Definite Load Applied

The brinell test is the most common hardness test applied to gray iron. Despite its shortcoming it remains one of the most practical hardness tests for gray iron. To make a brinell test the spot to be examined is smoothed off with a file, grinding wheel, or coarse emery. The sample is placed on the anvil of the machine and is raised by a screw until the surface just touches a 10 millimeter hardened steel ball held in the head of the machine. The ball is pressed into the sample by a system of levers or by hydraulic pressure (according to the type machine used). A definite load is employed, usually 3000 kilograms for testing gray iron. The load is applied until it comes to rest, usually within 30 seconds for gray irons. The ball then is backed off the work.

Since the load is constant, the area of the identation is inversely proportional to the *hardness* of the specimen. Softer metal will take a larger impression and vice versa. The measure of the hardness is the ratio of the load to the surface area of the impression and is expressed in kilograms per square millimeter. This is called the brinell hardness number. In usual cast iron testing, using the 3000 kilogram load, the diameter of impression is measured with a small microscope.

Dimensions Are Proportional

As the ball size is constant, the segment of sphere is proportional to the diameter of impression and the exact relationships have been computed mathematically. The brinell number for various diameters are obtained from a table supplied with the instrument. The numbers range from around 100 for the softest irons to somewhat above 200 for the harder irons. Brinell considerably above 200, say 230, usually means that some chill is present. The latter does not apply necessarily to nickel irons or to heat-treated irons.

The brinell hardness, or resistance to indentation, of a piece of gray iron depends on the combined resistance of its different microconstituents which were described in some detail in Part II of the series which appeared in the

Term Is Variable

WHILE reference to hardness often is made in discussing gray iron, that term has no accurate definition in that connection. Consequently it may mean one thing to the foundryman and engineer and something entirely different to the machinist unless a qualifying adjective such as machining, wear, etc. is used with the term hardness. As may be expected there are several methods for determining that quality, and these are described in this article which is the tenth of a series on gray iron engineering properties. In addition information on the specific gravity of gray iron is presented. The ninth article appeared in the Oct. 1 issue.

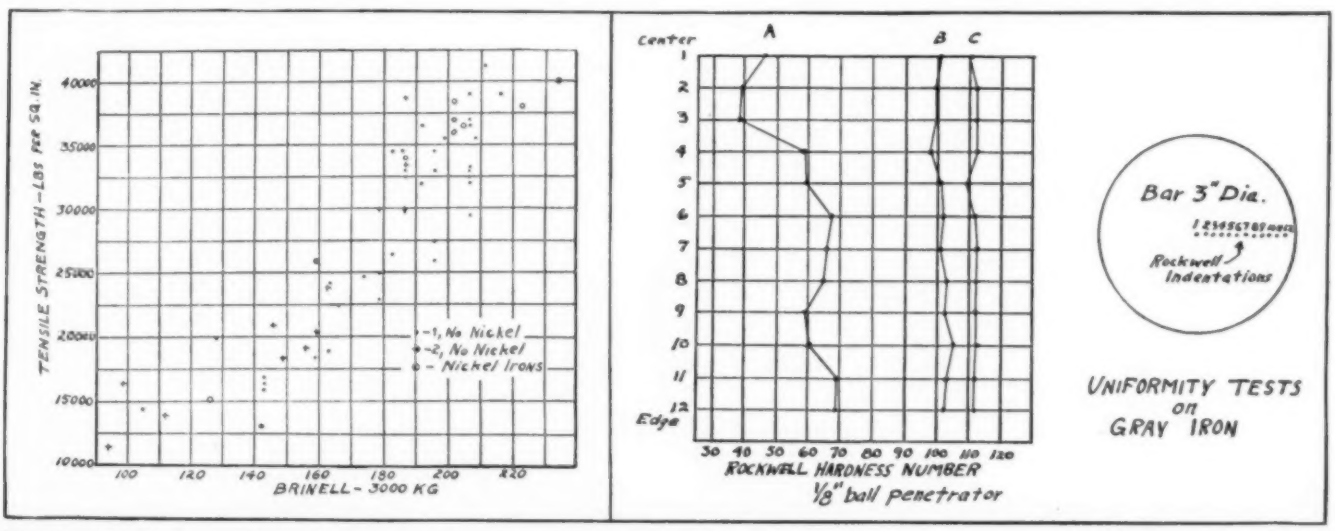


Fig. 62—Relation of Brinell Number to Tensile Strength. Fig. 63—Uniformity Tests on Gray Iron with Rockwell Tester

March 1, 1930 issue. The brinell hardness number of ferrite is about 100, that of pearlite 200 or slightly above, that of *unsupported* graphite negligible, while that of steadite and that of cementite are high, probably between 600 and 900.

An iron composed of all ferrite and graphite is likely to have a brinell number of about 100. Such an iron usually is quite low in tensile strength. Aside from likelihood of some gumminess and sticking to the tool under high speeds its machinability may be good. However, its wear resistance usually is poor and under ordinary foundry conditions it is likely to be open grained.

Pearlite Resists Indentation

While the graphite flakes offer little resistance in themselves they are rigidly held in the matrix and thus do not lower the hardness much. An analogy may be drawn to the action of sand under compression. A stick may be thrust into a pile of lose sand quite easily. However, if the sand is rigidly held in a container and a piston pressed down on it the resistance is great. One action of the brinell test is to start fractures through adjacent graphite flakes along the edge of the impression. This sometimes results in cracks and lowered brinell readings.

Pearlite, the eutectoid of ferrite and cementite, offers considerable resistance to the indentation, and the brinell of pearlitic irons generally is around 200. Such irons, if low in total carbon content possess good strength, fine wearing properties, and can be machined at reasonable speeds. As explained previously most commercial irons contain both ferrite and pearlite, hence their brinell usually is between 100 and 200. The soft irons of ordinary foundry practice may have brinells of say 130 to 150, the stronger, closer-grained metals 160 to 190, (in fairly large sections), whereas the strongest, irons, may have above 200 brinell even in medium heavy sections.

In small sections brinell values naturally are somewhat higher than for the corresponding irons in heavier sections. Phosphorus in small amounts does not materially change the brinell values, since the small hard particles of steadite are pressed into the softer matrix. Amounts over 0.50 per cent cause a noticeable change in hardness. MacKenzie, for example, reports an iron containing 4.80 per cent phosphorus with 477 brinell. A micro-

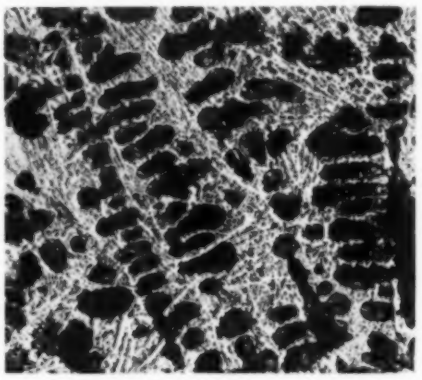


Fig. 64—High Phosphorus Iron According to MacKenzie, Etchant Picric Acid, 100 Diameters

graph of this metal is shown in Fig. 64. However the combined carbon was 1.75 per cent and the total carbon 1.81 per cent. An even better illustration of the hardening effect of phosphorus (by the same metallurgist) is an iron containing 2.25 per cent phosphorus 3.42 per cent total

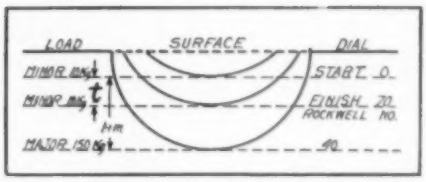


Fig. 65—Sketch of Indentation with Rockwell Tester

carbon and 0.87 per cent combined carbon which had a value of 286 brinell. Ordinarily an iron of this analysis and low in phosphorus would run from 180 to 210 brinell.

We have seen how increase in combined carbon from practically nothing (all ferrite) to about 0.90 per cent (pearlite) increases the brinell from 100 to 200. Further increase in the combined carbon increases the brinell considerably. In another instance MacKenzie reports an iron containing 3.75 per cent total carbon with 3.52 per cent combined carbon which showed 430 brinell. The phosphorus was 0.86 per cent and the silicon 0.44 per cent. In this case the high combined carbon was due the low silicon. Similar effect is produced by casting the iron against a chill.

Form Affects Hardness

Hardness can be increased by changing the form of the combined carbon, even though the amount is 0.90 per cent or under. Nickel, for example, in certain amounts changes the pearlite to sorbite, thus increasing the brinell with no increase in combined carbon. Also the form of the carbon can be changed by heat treatment. For example, Bolton took an iron normally about 200 brinell, and by quenching at 1600 degrees Fahr. and drawing to 700 degrees Fahr. in-

Table VIII

Specific Gravities of Five Gray Irons

Test Bar Diam.-In.	Total Carbon	Silicon	Manganese	Sulphur	Phosphorus	Tensile lbs./sq. in.	Brinell Number	Sp. Gr. at 20°C.	Pouring Temp.-Fahr.
0.50	3.52	2.17	0.60	0.086	0.32	31,347		7.181	
0.75	3.52	2.17	0.60	0.086	0.32	30,243	180	7.112	2440
1.00	3.52	2.17	0.60	0.086	0.32	21,744	162	7.116	to
2.00	3.52	2.17	0.60	0.086	0.32	13,485	112	7.087	2350
3.00	3.52	2.17	0.60	0.086	0.32	11,561	94	6.972	
0.50	3.50	1.71	0.48	0.087	0.36	41,712		7.174	
0.75	3.50	1.71	0.48	0.087	0.36	34,718	189	7.186	2510
1.00	3.50	1.71	0.48	0.087	0.36	29,885	183	7.185	to
2.00	3.50	1.71	0.48	0.087	0.36	18,475	147	7.114	2445
3.00	3.50	1.71	0.48	0.087	0.36	15,056	126	7.054	
0.50	3.26	1.68	0.46	0.083	0.33	43,971		7.214	
0.75	3.26	1.68	0.46	0.083	0.33	38,860	194	7.231	2545
1.00	3.26	1.68	0.46	0.083	0.33	34,575	191	7.140	to
2.00	3.26	1.68	0.46	0.083	0.33	24,248	172	7.087	2490
3.00	3.26	1.68	0.46	0.083	0.33	19,519	160	7.075	
0.50	3.16	2.40	0.57	0.048	0.27	41,887		7.145	
1.00	3.16	2.40	0.57	0.048	0.27	35,380	183	7.161	2540
2.00	3.16	2.40	0.57	0.048	0.27	21,060	146	7.081	to
3.00	3.16	2.40	0.57	0.048	0.27	15,657	99	7.020	2490
0.51	3.29	1.76	0.61	0.079	0.16	40,788		7.312	
0.77	3.29	1.76	0.61	0.079	0.16	37,415	205	7.280	
1.46	3.29	1.76	0.61	0.079	0.16	31,468	209	7.271	
1.95	3.29	1.76	0.61	0.079	0.16	26,880	196	7.282	
2.97	3.29	1.76	0.61	0.079	0.16	24,815	179	7.257	

Note:-The last group contained 1.25 per cent nickel and 0.08 per cent chromium.

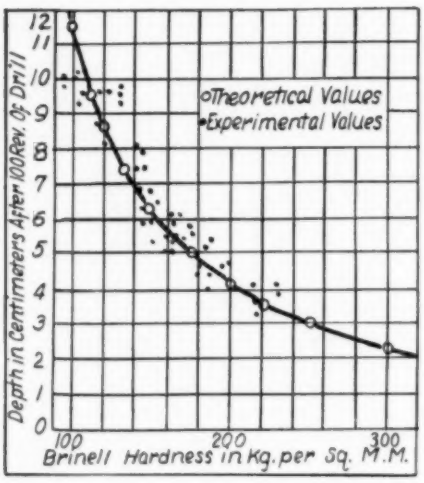


Fig. 66—Melle's Drill Depth and Brinell Relationship

creased the brinell hardness to 380.

The general relationships of brinell numbers to other physical properties has led a number of investigators to attempt to predict properties such as tensile strength from the brinell number. This has been done satisfactorily for certain steels. Notable among these attempts on gray iron are those of Portevin and of Schuez.

Gives Brinell Formulas

Portevin suggested the formula

$$K_z = 0.2H - 13,$$

where H is the brinell number and K_z = tensile strength expressed in kilograms per square millimeter. Schuez proposed

$$K_z = \frac{H - 40}{6}$$

These formulas and others of their type, while fairly accurate for irons of limited range in composition and cooling rate, do not apply over wide ranges in composition and for differerent cooling rates. Bolton, *Transactions* of the Institute of British Foundrymen, 1928, has shown the relation of brinell to tensile on a wide variety of irons as depicted in Fig. 62. Obviously the relationship is not sufficiently close for derivation of a reasonably accurate formula.

Similar attempts have been made to correlate brinell number and machining properties. For example, W. Melle, *Giesserei-Zeitung*, 1927, devised a standard drill test and compared the results of tests made on this apparatus with brinell hardness. He plotted the curve shown in Fig. 66. The abscissa represents the brinell number and the ordinate the depth of hole drilled. It will be observed that even under the ideal conditions of such a test variations of 20 per cent in cutting rate are found.

In commercial experience brinell number, while a general indicator certainly is not an accurate measure of machinability. The abrasiveness of the metal, for example, is not indicated by the brinell number—yet abrasiveness has a marked effect on tool life, hence on maximum practical machining rates.

As in case of tensile strength and of machinability, there is a general relation between wear resistance and brinell number. Under conditions of nonlubrication and beyond certain

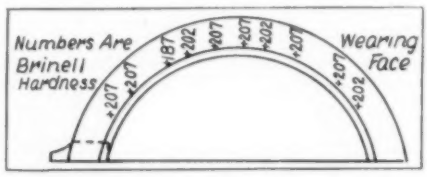


Fig. 67—Half of Valve Disk Showing Brinell Numbers

unit pressure intensities gray irons of higher brinell number possess greatter wear resistance.

The brinell test also is useful as an indicator of uniformity of hardness of a casting, and shows the presence of spongy and unsound areas. The brinell prospecting of a casting carried out by Bolton, *Transactions* of the American Foundrymen's association is illustrated in Fig. 67. That shows excellent uniformity on the wearing face and good uniformity in the interior except on the small flawed section in the center. These particular flaws were due to some tiny blowholes. Where shrinkage is encountered brinell may be low, say 70 to 100.

The rockwell hardness tester has attained popularity in steel hardness testing. In testing the hardness of a material a small ball point (1/16 inch diameter for one scale reading and ⅛ inch for another scale reading) is pressed into the specimen with a minor load of 10 kilograms. The depth gage dial then is set with index mark at zero. By releasing a small trigger the major load of 150 kilograms is applied automatically and gradually. This major load then is removed by moving a small hand lever, leaving the minor pressure applied as at the beginning. The difference in indentation between the depth at initial minor load and the depth of minor load after major load has been applied is the measure of rockwell hardness, shown as t in Fig. 65. This is read directly as the rockwell hardness number on the depth gage dial.

Because of the small size of the usual penetrator (1/16-inch diameter) and the hetereogenity of gray iron the rockwell test is not adapted to testing coarse grained irons in large sections. In some cases the penetrator goes right into a soft graphite flake area, in others into the harder matrix. In such cases a wide variation in readings may be found. For fine grained irons in small sectioned castings the test is a good commercial method. For example, sections from automotive sleeve valve castings are tested by the rockwell hardness tester in a quite satisfactory manner.

Larger Penetrator Preferred

The larger or ⅛-inch penetrator (E scale) is preferred for all gray iron work, as a larger area is under indentation pressure, and less eccentric results will be obtained. On account of the ease and speed of making the rockwell test it is a good policy to take several readings and if not too divergent, to average them for report. The indentations are small and will not seriously affect the usual machined surface. The maximum pressure is low, only about one-twentieth that of the brinell test, so there is little danger of breaking the tested piece or of starting serious cracks.

The scleroscope hardness tester developed by Shore, measures the rebound of a small test hammer on the test piece. Micro-character or scratch hardness testers have not been wide-

(Concluded On Page 118)

Table IX

Effect of Pouring Temperature

Bar No.	Total Carbon	Graphite	Combined Carbon	Silicon	Sulphur	Phosphorus	Manganese	Specific Gravity	Pouring Temp.-Fahr.
1	3.26	2.83	0.43	1.91	0.114	1.48	0.42	7.281	2602
2	3.25	2.84	0.41	1.88	0.097	1.41	0.27	7.262	2552
3	3.26	2.86	0.40	1.90	0.092	1.41	0.27	7.240	2534
4	3.26	2.89	0.37	1.90	0.096	1.41	0.27	7.225	2527
5	3.28	2.92	0.36	1.89	0.096	1.44	0.27	7.201	2482
6	3.28	2.93	0.35	1.90	0.094	1.44	0.27	7.158	2458
7	3.29	2.95	0.34	1.92	0.094	1.46	0.27	7.123	2426
8	3.30	2.99	0.31	1.90	0.093	1.47	0.27	7.085	2343
9	3.31	3.01	0.30	1.90	0.093	1.47	0.27	7.012	2321
10	3.31	3.13	0.18	1.91	0.092	1.47	0.26	6.936	2307

GRAY IRON INSTITUTE

Points To Future Work

PROGRESS in research work, merchandising methods and standardization of costs featured the reports of committees presented at the third annual meeting of the Gray Iron institute at Cleveland, Oct. 8. Talks by men from without the industry also featured these same subjects. The work of the institute during the past year was outlined in the reports of the officers and the important plans for the coming year were revealed by various speakers.

The annual gathering was successful in every respect. The attendance was good when present business conditions are taken into consideration. The interest shown in the various discussions was remarkable, especially in connection with the subject of costs. Since a number of ladies were present, a special program of entertainment consisting of a luncheon, a trip through a part of the new terminal development, a ride through the city and an afternoon tea were provided by a group of Cleveland ladies. The annual banquet was well attended.

Following a report of the nominating committee, made at the afternoon session by J. Rowbottom, Diversey Foundry Co., Chicago, for the nominating committee, the following directors were elected for a term of three years: J. H. Bruce, Bowler Foundry Co., Cleveland, H. S. Chafee, Builders Iron Foundry, Providence, R. I., Don McDaniel, Decatur Foundry Co., Decatur, Ind., R. D. Phelps, Francis & Nygren Foundry Co., Chicago, and John H. Pohlmann. J. W. Pohlmann Foundry Co., Buffalo. R. R. Monroe, Des Moines Foundry Co., Des Moines, Ia., was elected a director for a term of 1 year to fill the acancy left at the 1929 meeting.

Following the afternoon session, the board of directors met and elected the following officers: President, B. H. Johnson, Florence Pipe Foundry & Machine Co., Florence, N. J.; First Vice President, A. E. Hageboeck, Frank Foundries Corp., Moline, Ill.; Second Vice President, Don McDaniel, Decatur Foundry Co., Decatur, Ind.; Treasurer, W. J. Grede, Liberty Foundry Co., Wauwatosa, Wis.; Assistant Treasurer, H. C. Wilson, Cleveland Co-Operative Stove Co.

Institute Secures Cost Experts

ONE of the most important steps made by the Gray Iron institute since its organization was announced at the opening session by B. H. Johnson, chairman of the research committee. Oliver Smalley, consulting metallurgist, Brooklyn, N. Y., has been engaged in a technical capacity by the institute, and will have charge of preparing classification standards for gray iron castings. In addition, Mr. Smalley will answer such technical questions as are received by the institute and will provide technical and operating advice to members. Mr. Johnson stated that the committee considered the matter carefully before recommending to the board of directors that a technical man be employed.

Reports of officers followed the opening of the third annual meeting of the Gray Iron institute. In his report, President Seelbach traced briefly the developments which have been made since the first annual meeting was held in Philadelphia in 1928 and the final organization of the institute completed. The report of H. S. Chafee, Builders Iron Foundry, Providence, R. I., treasurer of the institute, showed that the finances of the organization are in a healthy condition and that the policy of pay-as-you-go has been followed closely.

B. H. Johnson

Arthur J. Tuscany, manager, stated that the gray iron industry is held in an entirely different light today than it was before the organization of the institute. The organization has experienced a pleasing growth with an increase of 62 new members during the year, pushing the total membership well over 250 at the end of the second year. However, Mr. Tuscany pointed out that the matter of increasing the membership is important, since additional revenue must be provided to carry forward many of the activities now planned. He cited some of the services rendered by the institute to the members and to the public at large, including the preparation of the monthly trade report, the collection of statistics for the wage report which contains information on gray iron foundry workers in all sections of the country, cost work, local chapters, etc. During the past year, 48 meetings have been held with industrial organizations in various parts of the country. Four local chapters have been organized, three during the past year, and the committee is giving attention to forming chapters in ten additional gray iron centers throughout the country.

The report showed that over 1000 copies of the uniform cost system have been distributed since it was introduced by the committee in January, 1930, and numerous publications have been prepared dealing almost entirely with merchandising problems.

A. E. Hageboeck

The institute has collected a list of gray iron casting users which contains 5000 names and is expected to grow rapidly. During the year the institute has prepared displays for several conventions.

John L. Carter, Sacks-Barlow Foundries, Inc., Newark, N. J., chairman of the cost committee, outlined the care and effort that was put forth in the preparation of the standard cost system to assure an accurate method of determining costs in gray iron foundries. Since introduction by the committee, the system has been given considerable publicity through distribution of copies and publication in THE FOUNDRY. The time now has arrived when the committee is ready to assist members in installing the system. Charles A. Klaus will devote half of his time to institute cost work in the eastern section and C. E. Mitchell, associate manager, working in conjunction with Mr. Klaus will handle the work at the central office. Mr. E. T. Runge also will devote a part of his time to institute cost work.

New Cost Program Arranged

The new program of the cost committee, now to be inaugurated, will permit the institute to send one of its cost experts to the plant of any member desiring to have the standardized system installed. After three months, the expert again will visit the plant to assist in preparing the quarterly reports and to solve any problems that may arise. There will be no charge for these two visits, but if further visits are deemed advisable, the experts will be available at a cost below that for which the same type of service could be obtained elsewhere.

The report of the finance and budget committee was read by H. S. Chafee, in the absence of Howard O'Neil, Western Foundry Co., Chicago, chairman of the committee. Mr. Chafee outlined the budget for the coming year which has been submitted to the board of directors. The amount to be expended for research leads the list of committee appropriations, with the cost committee receiving the second largest amount. H. F. Rockenbach, James Yocom & Son Inc., Philadelphia, in reporting for the membership committee, stressed the need for a larger membership, and suggested that the work of securing additional members be undertaken by each member, in conjunction with the efforts of the central office.

The merchandising committee, J. H. Bruce, Bowler Foundry Co., Cleveland, chairman, reported that a sales book on gray iron was in the course of preparation. Unusual uses for that metal, with information concerning the reasons for its selection for the particular purpose, will feature the book. The information first will be issued in bulletin form and sent to the large list of users of castings and later will be compiled in book form. The committee has been considering a slogan for some time and now is prepared to recommend to the board the following slogan: "Gray Iron for Rigidity and Permanence."

An alloy cost analysis is under way to determine the cost of using various percentages of alloys in gray iron castings. Mr. Bruce also reported that the committee recently held a meeting with the iron and steel committee of the National Association of Purchasing Agents to secure action on the standard sales agreement of the institute. After the merchandising committee had made a few minor changes, which in no way will influence the effectiveness of the agreement, the iron and steel committee approved the agreement and will recommend that the national association approve it. While the committee feels that the use of trade names may be a step in the right direction, it believes that the tonnage of castings cannot be increased in that direction, since designers may hesitate to use a product made only by one company and thus eliminate competitive bidding. For that reason the committee sees the standard classification of gray iron as one of the important activities facing the institute.

Following the luncheon at noon, Philip P. Gott, assistant manager, trade association department, Chamber of Commerce of the United States, Washington, addressed the members on "The Consumer and Producer Profit Through the Trade Association." Mr. Gott paid a high tribute to the institute in saying that few trade associations have accomplished as much in a little over 2 years as the Gray Iron institute. He stated that the trade association is an important agency today through which cooperative effort may bring about benefits to industry and to the consumer. In discussing the value of group advertising and trade promotion, he stressed the necessity for research to provide sound specifications for the product. An advantage may accrue through the certification of the product with an emblem which should indicate quality, advance the particular field of manufacture and increase profits. An analysis research of markets to determine the needs of customers and uses of the product should parallel technical research. An industry, which develops new uses for its product, also benefits its customers.

Capacity Exceeds Consumption

The speaker stated that systematized education is essential and pointed to the development of a sales manual as an enterprise that should not be overlooked.

Dr. Zay Jeffries, consulting metallurgist, General Electric Co., National Tube Co. and the Aluminum Co. of America, was the first speaker at the afternoon session, the subject of his talk being "How Research Is Benefiting Industry." Dr. Jeffries believes that the capacity for the manufacture of gray iron castings in the United States is greatly in excess of the potential or actual consumption. Such a condition makes it difficult to do business on a profitable basis and leads to price cutting. He sees no possibility of preventing more people

Don McDaniel

from entering the business, since the cost of a small plant is not high when compared with some industries. Regardless of the number of companies that may fail, a new crop always seems ready to fill the places.

However, in the gray iron industry

it is necessary for the producing plants to be scattered geographically. Due to delivery requirements and freight rates the foundries must be located within reasonable proximity to the source of consumption. If plants could be so scattered geographically that, upon getting the same scientific information, they would not interfere with each other, an ideal situation would be secured. However, this situation even cannot be approximated. The plants have a community of interest on one hand and are competitors on the other.

Community Research

Dr. Jeffries expressed considerable concern regarding community research, where everybody has all of the information on a certain art and no one group can gain an advantage. He seemed to feel that where research is carried on by the individual company, and the results retained for its exclusive use, the industry as a whole gained nothing, but the public may be benefited. Maximum progress cannot be made industrially until the stockholders of the corporation get a fair return on the money invested, the employe receives a fair return for services rendered, and the public or consumer group secures the product at a fair price. The speaker spent considerable time discussing the economics of employment, pointing out that the industry like the human mind and body are better off when in action.

In his opinion, there is a greater need in the United States today for research to determine price than for scientific research to make new dis-

William J. Grede

coveries and inventions. Balance is one of the essential factors when considering research programs. He cited an example to show how the neglect of product research on the part of a large automobile company cost that company millions of dollars and was responsible to a large extent for the over capacity situation in that industry today.

In referring directly to the subject of gray iron, he pointed to the prophecy of the late Henry M. Howe. In his book "Metallography of Steel and Casting Iron," which was published in 1916, Professor Howe expresses the belief that more is to be gained in the future in research in cast iron than in steel. Professor Howe visioned a much more scientific industry and pictured a cast iron with more and better properties.

Dr. Jeffries spoke of the border line products and the likelihood of an increase in that direction as time goes on. He mentioned the difficulty which may exist in saying whether a product is gray iron or malleable where the metal is produced as gray iron, cast in chill molds and then heat treated. He stated that much more is known concerning pearlitic iron than ever before. Close control of the composition is possible to encourage the formation of a pearlitic structure. Scientific methods govern the treatment and temperature of molds, which will permit an iron of a predetermined composition to cool to room temperature and produce the desired structure. Dr. Jeffries also spoke of the increase in utility of the semisteels and the advent of various alloys for gray iron. He pointed to the increased use of alloys in steel as an indication of what may take place in gray iron. In 1909, one ton of alloy steel was produced for 130 tons of plain carbon steel, while in 1929 the ratio was 1 to 15. While the alloy may not do as much for gray iron as it has for steel, consumers probably will demand in many instances the special qualities best obtained through alloys, according to Dr. Jeffries. He also mentioned a new class of metals which contain as high as 20 per cent of monel metal and in addition small quantities of chromium and manganese. This metal has a coefficient of thermal expansion approximately 50 per cent greater than ordinary gray iron, and is claimed to be especially adapted to automobile cylinder sleeves for use with aluminum pistons.

"Industrial Merchandising," was the subject of an address by John Wiley, King & Wiley & Co. Inc., Cleveland. Mr. Wiley advanced the belief that in the past, more attention has been paid to production than to merchandising gray iron. He discussed various factors which should be considered in the merchandising of that product and exhibited a chart which he had prepared covering the same subject. President Seelbach pointed out the value of this chart to the merchandising committee.

A. C. Denison, president, Fulton Foundry & Machine Co., Cleveland, developed some interesting discussion with a paper "Reasons Why the Standard Cost System Should Be Used." Mr. Denison pointed out the fact that a good cost system will be of the greatest value when the method of using the cost figures is applied in a uniform manner by competing foundrymen. An article by Mr. Den-

Oliver Smalley

ison, covering the same subject, appeared in the Oct. 1. issue of THE FOUNDRY on page 88. President Seelbach, in commenting on the discussion, stated that it will be necessary to standardize the application of the cost system to a particular class of work to secure the most effective system. He also pointed out that Mr. Denison is the first member of the institute to present a formal paper before an annual meeting.

To Provide Employment

At the close of afternoon session, B. H. Johnson, Florence Pipe Foundry & Machine Co., Florence, N. J., presented a resolution that the Gray Iron institute, through its members, do its utmost to provide employment for as many men as possible during the present depression through shift employment and other means. The resolution passed unanimously.

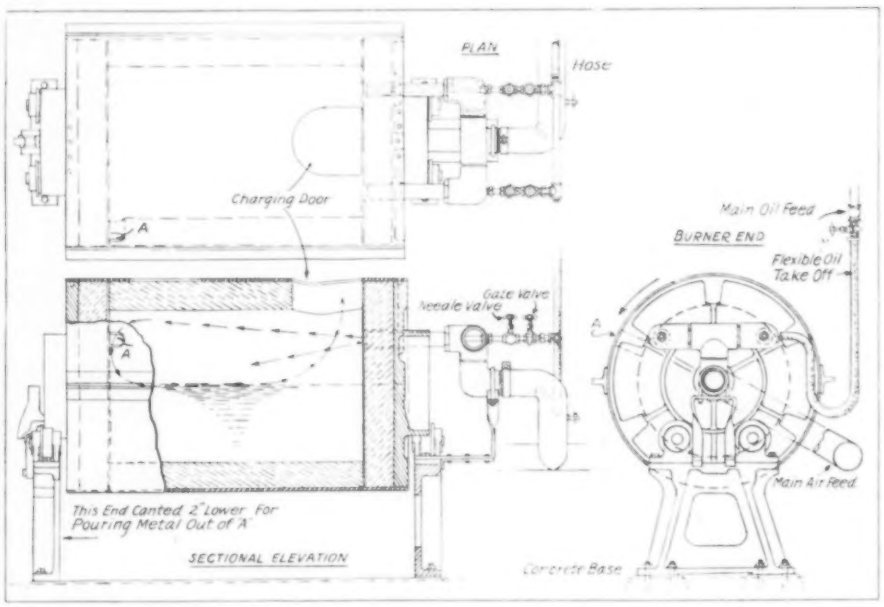
The annual banquet of the institute was held Wednesday evening in the ball room of the Hotel Cleveland. Hon. James T. Begg, in an address on "Some Problems of Our Economic Future," stated that the Sherman anti-trust law should be repealed or revised to permit industry to adopt such prices as will provide a profit. The speaker pointed out that this would do more to stabilize business and provide a solution to unemployment than all of the other methods advocated.

Dan M. Avey, Editor, THE FOUNDRY, closed the program with a summary of the high lights of the day's activities. Through scare headlines on a tabloid paper, Mr. Avey covered everything from world news and society features to the field of sport.

Brass Melting Furnaces Are Fired with Two Oil Burners

By Charles Vickers

OIL-FIRED, rotary, noncrucible furnaces for melting nickel silver alloys, bronze, brass and aluminum similar to that shown in the accompanying illustration have been in use in Australia a number of years, where they were devised by Tasman Storey, Storey Bros. Ltd., Sydney, New South Wales. The firm specializes in the casting of nickel silvers and other nickel alloys, brasses and bronzes of the usual type and also aluminum. The furnace presents several interesting and unusual features. It is a two-burner furnace, and both burners are located on the one end of the cylinder, and can be operated together or singly according to the melting point of the alloy to be melted. For nickel alloys and for bronze both burners are required to melt rapidly. At the start of the heat of an aluminum alloy it is advisable to light both burners to bring the metal to the liquid state rapidly. After it has reached that point it is convenient to be able to shut off one burner for aluminum is a deceiving metal to melt on account of its high specific heat.



The Burners Are Located at One End of the Furnace. The Pouring End Is Two Inches Lower than the Burner End

It soaks up heat for a long time before it commences to melt. As shown by Anderson in his book on the metallurgy of aluminum, it requires about twice the amount of fuel to melt aluminum or its alloys, as is necessary to melt a 70 per cent copper—30 per cent zinc, yellow brass. However, after the aluminum is molten, it takes a long time to cool as it parts slowly with the heat it has soaked up, known as the latent heat of fusion. This fact will be attested by many a young startled foundryman, after an attempt to pick up a nice, white aluminum casting that seems to have laid on the floor plenty long enough to have become cool.

Another interesting feature of that oil-fired furnace is found in the position of the burners with respect to the interior of the furnace. Instead of being introduced through the trunnions as in conventional American type, they are raised about one-fourth of the inner diameter above the furnace center. The position of the burners clearly is shown by the sectional elevation. It was thought that the central type of burner limited the capacity of the furnace too much, and presented a constant danger of being put out of commission when worked to capacity by metal flowing into the air lines an accident rendered impossible by the raised burners.

From the author's experience with central burner furnaces such danger, it would appear, is more imaginary then real, for he has never known it to happen in any furnace using center burners. The heats are adjusted to the capacity of the furnace which takes into account the presence of the molten flux floating on the surface of the metal, and which is so vitally necessary in protecting the metal from the punishment of the oil flame.

When two burners are located at one end of a furnace it is obvious both cannot be at the center. Therefore, in short furnaces, only one burner is installed, and it apparently functions satisfactorily. The Storey furnace is 3 feet long inside and about 22 inches internal diameter. The sectional elevation shows the path of the flame direct to the far end of the furnace where it is deflected back toward the burners. The products of combustion escape through the charging hole located at the burner end. For pouring the metal from the furnace, a pouring spout is provided on the end opposite the burners. At that end the furnace is canted two inches lower than the burner end to insure complete drainage of the molten charge. The spout is shown at *A* in the illustration. The capacity of the furnace is from 336 to 560 pounds and it appears to be a satisfactory melting unit, as it has given continuous service over long periods without requiring costly upkeep.

One such furnace worked daily for 18 months on aluminum without relining, and for 5 months of the time it was working both day and night. Tasman Storey, who developed the furnace, has had an adventurous career, and spent considerable time in the United States during the World war as an engineer on naval work with Cramps of Philadelphia, and in the Bethlehem shipbuilding yards as night superintendent of the submarine section. His father, now deceased, was at one time premier of the state of New South Wales.

Correlation of Mechanical Tests

Involves Many Difficulties

By J. G. Pearce

Part II

THE transverse test remains the simplest, cheapest and most generally used test for cast iron, and breaking load and deflection figures are understood universally. Its mode of interpretation often yields results which are contrary to facts, and precludes comparison between transverse and other specific stresses such as tensile and compression and between transverse results on bars of other shapes and sizes of the same material. The author recommends, as a method of expressing transverse results, the conversion of breaking load into a transverse-rupture stress per square inch of the cross-section at fracture. The transverse test as ordinarily conducted forms a case of a weightless, end-supported, centrally-loaded beam.

Beam Formulae Apply

For supports L inches apart, a central load of W pounds gives a bending moment at the center of

$$\frac{WL}{4}$$

The resistance offered by the beam depends on its size and shape, and may be expressed as fZ, where f is the specific resisting stress set up in the beam, and Z is the section modulus for a given section, taking into account the size and shape of the section. Within the elastic limit,

$$fz = \frac{WL}{4}$$

When the elastic limit is passed, the formula ceases to be strictly true; but it is convenient to measure the stress f at fracture by means of the value

$$\frac{WL}{4Z}$$

For a standard bar

$$\frac{L}{4Z}$$

is constant, so that $f = KW$. A straight line conversion is possible from W to f, and can be used for bars accurately machined to a given size before testing.

In practice most bars are tested as cast, and it is practically impossible to cast a bar accurately to specified size. Where differences between cast and specified sizes are not ignored, the practice has grown up of converting by proportion the result obtained on the cast size to that which would be obtained on the specified size.

Proportion Causes Error

The author has shown that that procedure is fallacious, since it assumes that the transverse-rupture stress is the same for both sizes. This is not the case, for the larger of the two sizes will have the lower breaking stress, and the greater the difference, the more pronounced will be the error. While the error is small in converting to a nominal specified size from a closely approximating cast size, the conversion from small to large bars, and vice versa, gives completely

Explains Effects

INTERESTING discussions on the effect of varying melting conditions, change of strength with section and composition, and the interpretation of the deflection figure in the transverse test are included in this, the second and concluding section of an article abstracted from the exchange paper of the Institute of British Foundrymen, and presented at the Cleveland convention of the American Foundrymen's association. Other points brought out are comparisons of the tensile and transverse strengths, new specifications adopted by the British Engineering Standards association, and further discussions on the value of repeated impact, brinell hardness, and fatigue tests are included. The author is director and secretary of the British Cast Iron Research association. The first section of the article appeared in the Oct. 15 issue of THE FOUNDRY.

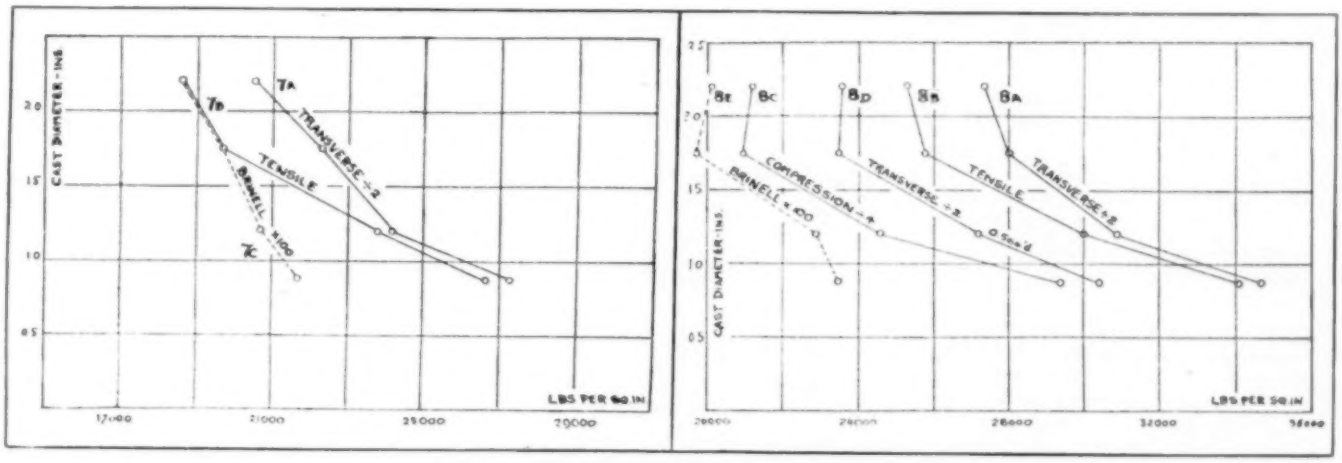


Fig. 7—Variation of Transverse, Tensile Strength and Brinell Hardness with Diameter of Cast Bar for Skin-Machined Bars. Fig. 8—Variation of Same Properties Plus Compressive Strengths with Diameter of Cast Bar for Skin-Machined Bars, A and B, and Bars, C and D, Machined to 0.564 Inches Diameter

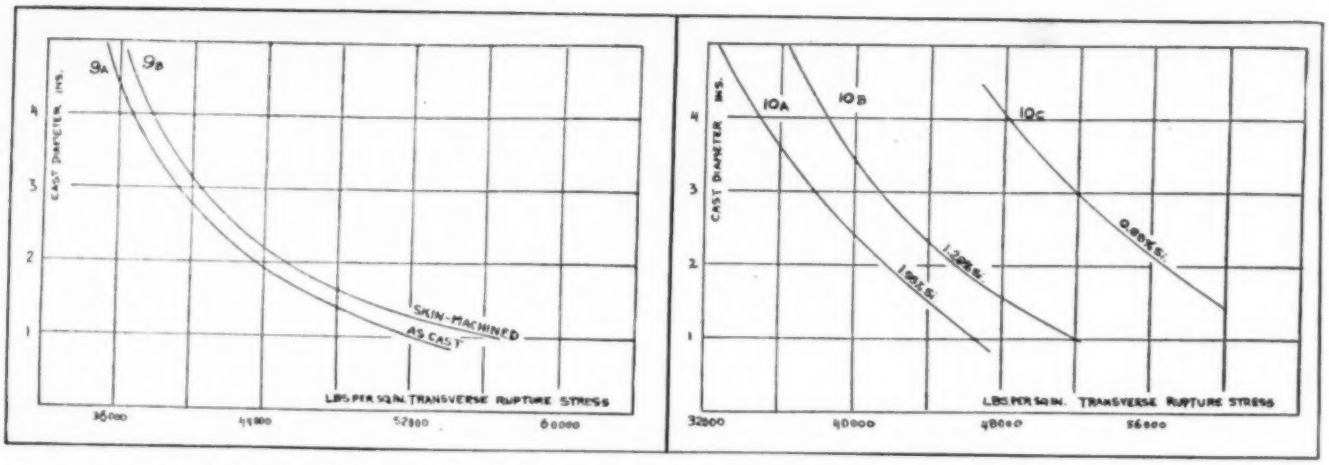


Fig. 9—Variation of Transverse Strength with Diameter for Cast and Skin-Machined Bars. Fig. 10—Same for Mixtures of Remelted Pig Irons

erroneous results when used in tests.

By substituting appropriate values for Z in the formula, the transverse-rupture stress can be expressed in terms of bar dimensions. For the round bar generally used in the United States and now adopted as the British standard, $Z = 0.0982d^3$, where d is the bar diameter and

$$f = \frac{WL}{0.39d^3}$$

For a bar tested on 18-inch centers, f in pounds per square inch becomes

$$\frac{0.0205W}{d^3}$$

for W in pounds.

The nature of the change of strength with section is illustrated in Figs. 7 and 8, where curves 7*A* and 8*A* represent the transverse strengths of two irons of analyses given in Table II for bar diameters of 2.2, 1.75, 1.2 and 0.875 inches. Half the transverse strength in pounds per square inch is plotted against diameter, and it is clear that transverse strength increases with diminishing diameter.

Fig. 9 shows a similar curve drawn smoothly through the points, for a series of eleven bars from the same ladle, varying in diameter from 0.5 to nearly 5 inches. Curve 9*A* represents the curve obtained on the bars as cast, and curve 9*B* on the silicon bars skin-machined, which are higher by approximately 5 per cent. The amount removed in each case was about 0.05-inch. The span in this series of tests was 21 inches.

The slope of the curve is determined by many factors in the melting conditions apart from composition, and, while these curves are of similar type, the multitude of factors affecting the issue renders it unlikely that the change is represented by any simple physical law. There seems little point in plotting the results on a logarithmic basis as suggested in *Proceedings*, American Society for Testing Materials, report of sub-committee XIV, committee A-3, Vol. 1, 29, I, 1929.

A number of such curves have been so treated without yielding a simple physical law. In some irons the size-strength curve is almost straight and vertical, the heavy sections being nearly as strong specifically as the lighter sections, while in other cases the specific strength of thicker sections falls off sharply. Size-strength curves may be prepared for a given set of melting conditions for various compositions, particularly silicon contents. As would be expected, the low silicon irons, being strongest, are on the extreme right of the chart, and intermediate and high-silicon irons are more or less parallel and farther to the left as the silicon in the irons increases.

Strength Varies

Fig. 10 shows a chart for three mixtures of remelted pig iron from one foundry, analyses being given in Table II. It is obvious that the establishment of a continuous variation of strength with section provides the basic justification for specifying a test bar for a given casting approximating the thickness of the casting. It may be noted that the diameter d, chosen as an index to rate of cooling, is reciprocally proportional to the ratio

$$\frac{\text{area}}{\text{volume}}$$

recommended by J. W. Bolton, which in a cylindrical bar is

$$\frac{4}{d}$$

The same holds true in a long bar if the influence of the ends are squared. The author has not found this ratio satisfactory for complicated shapes.

The change of strength with section for a given range of sections is a maximum for separately cast bars. In a casting of varying sections, the thin parts will gain heat from thicker parts and cool more slowly, and vice versa for thick parts. Hence, while results on bars do not apply to the actual castings, they may be regarded as furnishing the extreme case. A size of test bar may be chosen by experiment in excess of the dominating section of the casting which will give strengths similar to the casting.

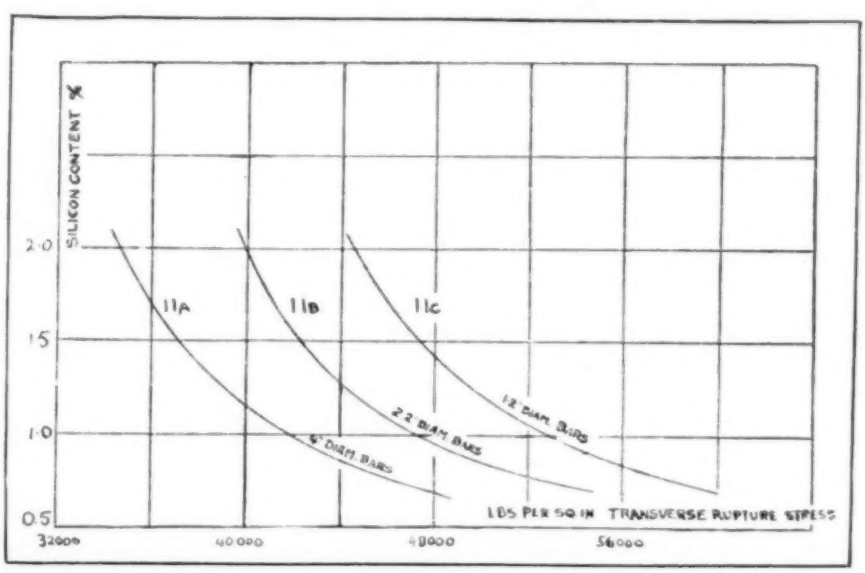


Fig. 11—Variation of Transverse Strength with Silicon Content for Bars of Varying Diameters

The tests mentioned previously have been carried out on a strictly standardized basis, for the transverse-rupture stress varies not only with size but also with shape. British Cast Iron Research association has shown, for instance, that a square bar is weaker, area for area, than a round bar; and that the result is not due to a casting effect but to a testing effect, for the difference between round and square bars (when tested as cast) persisted when round bars were tested after machining from the square, and square bars after machining from the round. The stress distribution during the test doubtless differs markedly from the theoretical in each case, and the differences are not parallel as between the two shapes.

Therefore, it is necessary to add to the previous conclusions the requirement that strength of cast-iron bars examined by the transverse test must be determined on standard bars tested by standard procedures.

It is evident from Fig. 10 that strength changes with silicon content as well as with size. In Fig. 11 the transverse strength is plotted against silicon content for each of the three mixtures illustrated in Fig. 10. As might be anticipated, there is an increase of strength as silicon content diminishes. Similar curves derived from results published by Rother and Mazurie *Transactions*, American Foundrymen's association, vol. 34, 1926 are practically parallel straight lines.

Curves Are Valuable

Such a group of curves should be of great value to any foundry determining them for its own mixtures, as silicon is the usual basis of control. They enable the strength obtainable in a given size of bar to be predicted for a given silicon content, and vice versa. They should be of value to designers, and they permit the influence of changes in the melting program, such as the use of steel additions, to be readily determined.

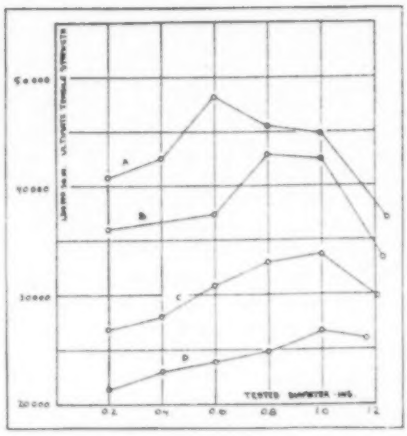


Fig. 12—Tensile Strengths of Four Foundry Irons at Various Machined Diameters

The effect of variation in conditions of melting may be illustrated by the following: A score of foundries were asked to cast bars from a cupola-melted mixture made in the ordinary way of business and suitable for engine practice. Each mixture was represented by four bars, 0.875, 1.2, 1.75 and 2.2 inches in diameter, three of these being standard British bars. A great variety of results were received which showed a wide divergence in melting practice. However, each set of bars in the tests showed consistent results among themselves with regard to change of strength over the range of sections cast, as shown by Figs. 7 and 8, which represent two of these mixtures.

Furthermore, where more than one mixture came from the same foundry with the same melting conditions, the change of strength with silicon content was similar to that shown in Fig. 10. Where the melting conditions had been altered, this relationship did not hold. Fig. 12 will serve to illustrate this, for all four mixtures there represented were poured in one foundry and the strongest iron *A* had a silicon content almost as high as any other iron in the group. *B*, *C*, *D* followed in this order of increasing silicon, as would normally be expected from the strengths shown.

Fig. 13 shows a curve in which the tensile strength is plotted against transverse rupture stress. On the chart, specified transverse and tensile tests for a given iron can be defined by a point which is the origin of an upper right-hand quadrant. Any irons tested, falling in this quadrant, pass the specification. Thus, closed squares marked *C* and *A* define the mechanical properties of the grades *C* and *A* of the national specification 321/1928, British Engineering Standards association. Similarly, open squares *P*, *Q*, *R*, *S* refer to four specifications recently adopted. As the German Standardization Committee specification, D.I.N. 1691, while double squares *W*, *X*, *Y*, *Z* refer to A. S. T. M. specifications A-48-18, A88-24, and A124-28T for ordinary grades and high-test iron.

Despite a considerable measure of scatter, there is an approximate relation between transverse and tensile tests. That part of the curve drawn as a straight line broadly averaging the British and German figures, gives for tensile strength in pounds per square inch, T, and transverse strength in pounds per square inch, R, the equation $T=5.59R-4000$. Any pair of values gives the approximate ratio R/T as 1.86. For a given tensile strength, the British specified transverse values lie between the German, which are the lowest, and the American, which are highest. The ratio of R to T is not constant. It diminishes for high quality and increases for lower quality irons, as the range of tensile strengths is wider than the range of transverse strengths.

Deflection Gives Information

The deflection figure on transverse yields much important information, and the deflection figures for all the transverse tests given in this paper have been obtained. In many bars, the deflection has been taken at intervals in the loading in connection with the study of the elasticity of cast iron, since the breaking deflection is only partly elastic, the remainder being plastic, although the major part of the deflection, some 80 to 90 per cent, is elastic.

The engineer prefers the tensile test to any other, and with good reason. There is a vast body of accumulated experience in works on the technique of tensile-testing influence, and it has been the author's experience that for cast iron the tensile test, properly conducted, is sensitive, consistent and reliable. Regular changes with composition for similar melting conditions and duplicate test results repeatedly confirm this. Care must be taken that the pull is axial and, in

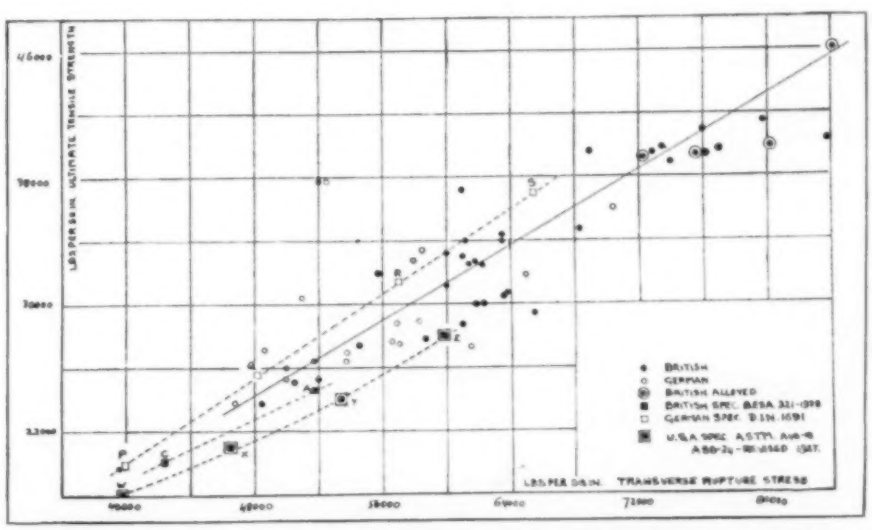


Fig. 13—Transverse and Tensile Strengths of 1.2-Inch Bars from a Number of Foundries, with Recent Specified Figures

this connection, it is advantageous to have the test pieces, which require no parallel pieces for gage lengths, tapering to the center where the fracture takes place. A parallel gage length is neither necessary nor desirable. In this respect, the standard American test appears preferable to the British test, with its gage length of two inches.

Tensile test behaves similarly to the transverse in that skin-machined bars have a higher strength than bars pulled as cast, although the essential difference in testing procedure makes a comparison difficult. When stock is removed beyond that amount which gives optimum strength, the tensile strength diminishes, as shown in Fig. 12, which is on a series of 1.2 inches bars cast in four mixtures. The higher the quality of the iron, the less important becomes the amount machined off, as shown by *A* and *B*.

Tensile tests show the same relation between strength and size as transverse tests, and Figs. 7*B* and 8*B* show tensile results on the same irons as illustrated in 7*A* and 8*A*, respectively.

The compression strength of cast iron, seldom taken nowadays as a routine test, shows the same variation with cast diameter as tensile and transverse. The compression curve for iron 7*A* is shown as 7*C* at a fourth the tensile scale, on bars 0.564 inch in diameter. The half and fourth parts taken for transverse and compression do not imply that

$$\frac{R}{T} = 2, \text{ and } \frac{C}{T} = 4,$$

are the best ratios for these tests. Some degree of separation between the curves is desirab'e to avoid confusion in illustrating various results.

The new British Engineering Standards association specification makes some radical departures in testing and, although the actual qualities of metal covered are only two in number, the testing provisions can be utilized for any size or type of casting. The main features are as follows:

(1) No chemical analysis is specified, the manufacturer being left to obtain the required mechanical properties by any mixture he chooses. This confirms the principle previously accepted in Great Britain that the quality of cast iron, for engineering purposes can be defined by mechanical tests.

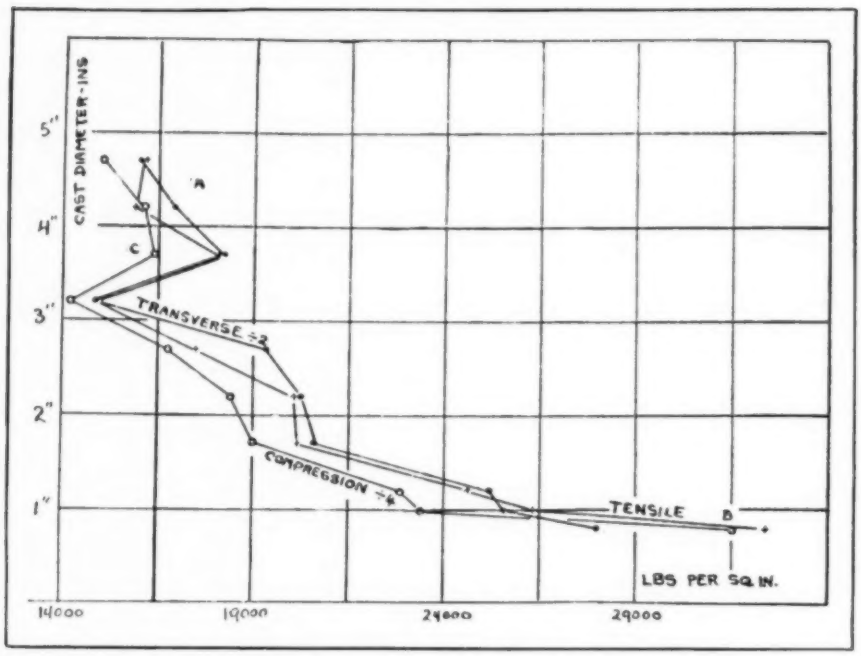


Fig. 14—Transverse Tests on Series Shown in Fig. 9 with 0.8-Inch Diameter and Tensile and Compression on 0.564-Inch Diameter Plotted Against Cast Diameter

(2) The principle of a separately cast test bar is embodied in a British specification for the first time, although the purchaser still has the option of specifying cast-on bars if the design and method of running permit.

(3) Both transverse and tensile tests are specified, although the purchaser may be satisfied by either alone, if he so prefers.

(4) The cylindrical test bar is adopted for the first time in a British national specification. This renders the square and rectangular bars obsolescent.

(5) The important principle is adopted for the first time of specifying a size of test bar comparable with size of the casting. Three sizes are provided. The 1.2 inch bar was chosen because it already has received a measure of sanction as an international bar (New York, 1913), representing castings between ¾ inch and 2 inches main thickness; castings below 0.75 inch main thickness are represented by the 0.875 inch bar, and those with main thickness above 2 inches use the 2.2-inch bar.

The 0.875 inch transverse bar is cast 15 inches long and tested on 12-inch centers, and for tensile, reduced to 0.564-inch diameter. The 1.2-inch bar is cast 21 inches long and tested on 18-inch centers, and for tensile, reduced to 0.798 inch. The 2.2-inch bar is cast 21 inches long and tested on 18-inch centers, and for tensile, reduced to 1.785 inches. All tests in this article, unless otherwise specified, are carried but in accordance with that specification. For other tests, in transverse testing a range of diameters, it was found desirable to standardize the span at 21 inches, as in Figs. 9 and 10. The compression tests were carried out on cylinders 0.564 inch in diameter and 1.128 inches long.

Strength Diminishes

Strength in the cast bar continuously increases as section diminishes. For some tests, compression, repeated impact and fatigue, it is imperative to machine a bar for testing, whatever its cast diameter, to a small diameter of the order of one-half inch. What is the effect on the test results? A set of transverse bars similar in composition to the series illustrated in Fig. 9 was tested by machining to 0.8 inch diameter throughout, and these also were tested in tensile and compression at 0.564-inch diameter. The actual strengths obtained are plotted against the original cast diameter in Fig. 14*A*.

It will be seen that the increase in strength with diminishing section is marked. Taking into consideration the change in the scale, it will be noted that a smooth curve through the points in *A* would be of the same character as, but to the left of, the similar curve on the cast or skin-machined diameters, shown in Fig. 9. This weakness occurred in spite of the reduced span of 10 inches. Tests taken on small bars machined from larger diameters will be relatively weaker than tests taken on the same bars at their cast or skin-machined diameters.

If tests are made on a series of skin-machined diameters, represented by a curve *A* in Fig. 15, and the same test be made on the same series machined to the smallest diameter *d*, the change in strength series would be represented by a curve *B*, the difference depending on factors of composition and melting conditions. A curve *C* might represent all bars machined to a diameter *D* larger than *d*.

Therefore, while the assumption that tests may be made indiscriminately on any size of bar that suits the testing machine, irrespective of its relation to the cast diameter, is erroneous, the strength of a machined bar is determined by its strength in the cast state. Short por-

tions of curves such as *A* and *B*, Fig. 14, at present may be regarded as parallel, without involving a serious error.

In Fig. 8 the marked movement of the compression curve to the left is explained by the fact that each test was made on a 0.564-inch diameter bar. Had it been practicable to test each bar diameter in compression without more than skin-machining, it doubtless would have appeared adjacent to the tensile and transverse curves *A* and *B*. Partial machining essential on tensile bars also explains that *B* is to the left of *A* in Figs. 7 and 8. Furthermore, in Fig. 8, *D* represents a series of transverse tests on bars represented in *A* machined to 0.564-inch diameter, tested on 7-inch centers. In spite of the shorter span, there is a distinct fall throughout in transverse strength.

Curve Is Not Smooth

Returning to Fig. 14, the transverse size-strength curve is not shown as a smooth curve because, for some reason at present obscure but probably connected with an unintended change in melting conditions, the 3.7-inch diameter bar showed an increase in strength over the 3.2-inch bar. It was thought that, if compression and tensile tests measured the same fundamental property as the transverse test, the compression and tensile values would show the same discontinuity. The tensile curve is shown at *B* and the compression curve at *C*, Fig. 14.

As previously, a tensile scale is adopted and the transverse results *R* plotted at one-half, and compression results *C* at one-fourth their true values. The mean value for

$$\frac{R}{T}$$

is, in fact, nearly 2, and for

$$\frac{C}{T}$$

nearly 3.75. Thus, Fig. 14 shows that, when tested at the same diameter, tensile, compression and transverse results maintain a constant ratio to each other; and furthermore, that tensile, compression and transverse tests measure the same basic property of cast iron.

The development of high-quality irons has created a need for a test which will discriminate between ordinary and special irons with greater sensitiveness than ordinary static tests. The transverse test is least satisfactory in this respect. Tensile test is better. Shock tests appear to have possibilities, but single-blow tests, particularly those involving a notch, have not been found really satisfactory, while the time taken to conduct a fatigue test rules it out at present as a routine test, although some promising rapid methods are being developed to make it a routine test.

A convenient test which falls intermediately between these two types of test is a repeated-impact test. In the form used by the British Cast Iron Research association, the machine delivers about 80 blows per minute on a standard ⅝ inch round bar machined to 15 millimeters, with a round notch 3 millimeters wide and 1 millimeter deep, rotated through 180 degrees between the blows. The number of blows to fracture is recorded. Several combinations of falling weight and drop can be used by suitable adjustment. The B.C.I.R.A. standard has an energy impact of 0.48 foot pounds; that is 4.8 pounds falling through 1.2 inches.

The test is used on a purely empirical basis, and it is found that the impact value rises with diminishing silicon and phosphorus, diminishing graphite content and diminishing size of graphite.

Brinell hardness, if conducted with the 10-millimeter ball, gives useful comparative data. That test does not appear to fall in the larger sections or rise in smaller sections as much as tensile or transverse strength. The slope of the brinell curve is greater. Brinell hardnesses for the two irons shown in Figs. 7 and 8 are given at 7*C* and 8*E* for each diameter of bar, each point being the mean of three readings on the shank of the tensile bar. The relation between brinell hardness and tensile or transverse strength, even for the same composition and conditions of melting, depends upon the size of standard test bar employed.

Although comparatively little has been done in Great Britain on fatigue of cast iron, the results obtained by H. F. Moore, S. W. Lyon and N. P. Inglis, *Bulletin* 164, Engineering Experiment station, University of Illinois, 1927, have been followed with interest. Prof. C. H. Bulleid, University college, Nottingham, has made a number of Wohler fatigue tests on cast iron, and in conjunction with the B.C.I.R.A.

Several conclusions may be drawn from the foregoing data. The proper correlation of mechanical tests and comparison necessitates the use of standard bars of specified shape and size and standard test procedures, preferably on an international basis. The 1.2 inch diameter bar, representing a large proportion of castings made, and accepted in the leading industrial countries, is particularly suited for experimental work. Under constant melting conditions, gray irons of the same composition vary continuously in transverse, tensile, fatigue and compression hardness,

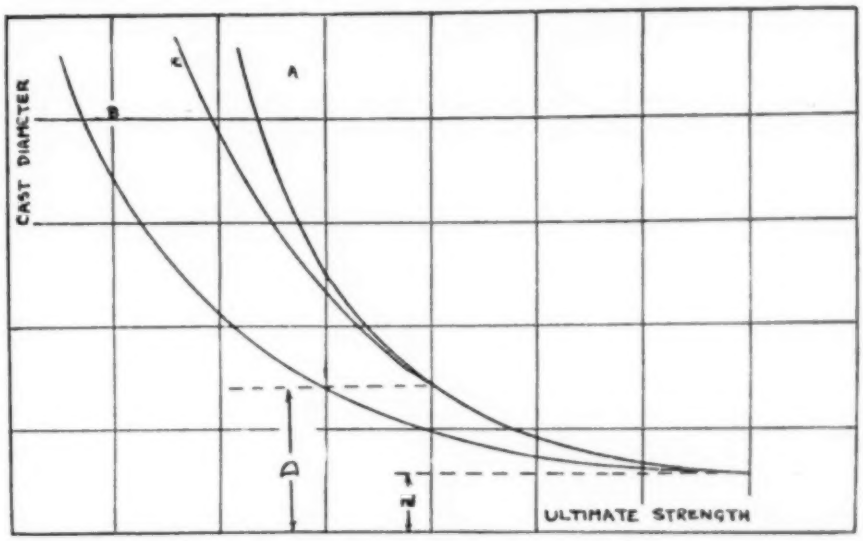


Fig. 15—Theoretical Variation of Strength with Cast Diameter at Various Tested Diameters

with section, strength diminishing as the section increases. Under constant melting conditions, gray irons in the same size of bar vary continuously in transverse, tensile, fatigue and compression hardness and with composition especially silicon content, strength increasing within the gray range as silicon diminishes. Differences in strength between gray irons of the same composition and same size of bar are an index to differences in melting conditions. Variation in strength of a series of bars cast at different diameters is shown equally well by tests at the cast size or at a constant machined diameter, but the latter are lower on account of stock removed. The extent of the difference depends on the nature of the iron tested. Skin-machining increases the strength of gray cast-iron bars. Transverse, tensile and compressive tests measure the same basic property of gray iron and, for standardized tests on the same size of bar, bear a constant ratio to each other for the same iron melted under the same conditions. Approximately, the transverse is double and compression four times the tensile strength.

Memorial *Commemorates* Achievements of WESTINGHOUSE

The Figure of George Westinghouse Leaning Over His Drawing Board Is Shown in the Center Medallion

LEADERS of the nation's business, industry and scientific research paid respects to the late George Westinghouse, founder of the Westinghouse industries, in dedication ceremonies at the recent unveiling of a memorial to him in Shenley park, Pittsburgh. The memorial was erected by the Westinghouse Memorial association, composed of 54,251 members, mostly Westinghouse employes, who, with the assistance of appropriations made by the Westinghouse Electric & Mfg. Co. and the Westinghouse Airbrake Co., financed the undertaking.

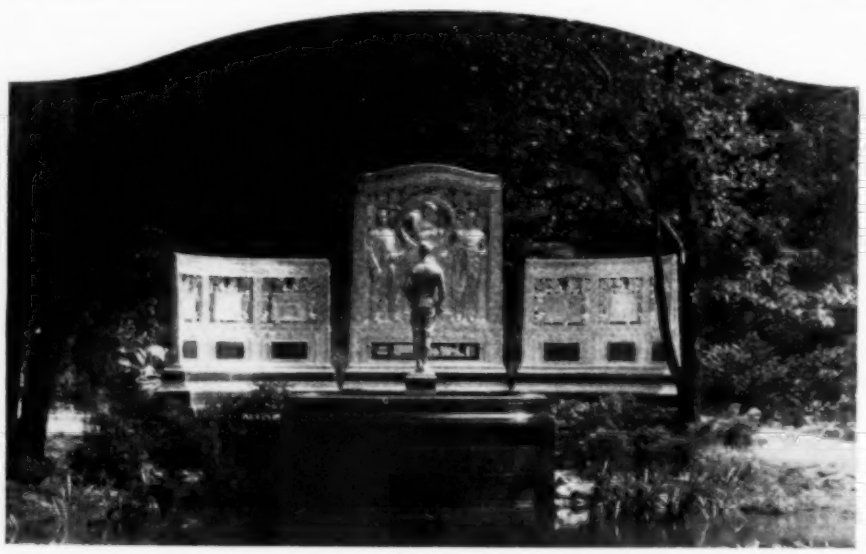
The dedicatory ceremony was presided over by E. M. Herr, vice chairman of the board of directors of the Westinghouse Electric & Mfg. Co. The program included addresses by A. L. Humphrey, president of the Westinghouse Air Brake Co.; James Francis Burke, former congressman and now general counsel of the Republican National committee; and Bishop Alexander Mann of the Pittsburgh Episcopal diocese. Following these addresses, George Munro, representing the Westinghouse veterans, presented the memorial; the monument was unveiled; and Mayor Charles H. Kline made the speech of acceptance in behalf of the city of Pittsburgh. The memorial thus dedicated represents the combined efforts of Henry Hornbostel, architect; Daniel Chester French, sculptor; and Paul Fjelde, sculptor; as well as other talented artists who were associated with them. The monument itself is cast in bronze and stands on a base of Norwegian granite, a jet black stone with embedded crystals of felspar which gleam blue where the light strikes them. Its principal component, as shown in the accompanying illustrations, is a large, central panel flanked by two semicircular wings all of which are cast in bronze. The central figure is of an American boy confronting the inspirational achievements commemorated by the central and flanking panels. All of the panels and the figure of the boy are made of gold-leafed bronze with Norwegian granite inserts.

Gold leaf has been used lavishly on the monument because, according to Henry F. Hornbostel, the internationally-known architect, who, with Eric Fisher Wood, designed the work, "it will give the monument an interesting surface which will be enhanced by the smokey atmosphere of the city, will never become black, and will endure for thousands of years, as is shown by traces of gold still to be seen on the monuments of the Roman Caesars."

The central panel carries a medallion of Westinghouse at his drawing board, at one side of him a skilled mechanic and at the other side an engineer, both typical of their professions. On a plaque below the figure of Westinghouse is a suitable inscription commemorating the achievements of this noted "empire builder," who died in 1914. At the base of the panel is a reproduction of a railway train carrying the first trial equipment of the air brake, built in 1869. Each of the flanking wings is divided into three panels and on each panel is depicted in low relief one of Westinghouse's achievements.

Previous to its erection, the entire monument was modeled in wax by Massaniello Piccirilli under the guidance of the architect. Execution of the construction work consumed nearly 14 months. The bronze castings were made by the Gorham Bronze Co., Providence, R. I. Not the least important part of this memorial is its setting. A valley is cut in a steep hillside, and in this valley, where it is hidden until one is almost upon it, the memorial has been

(*Concluded on Page* 119)



A Front View of the Westinghouse Memorial Discloses the Beauty of its Sylvan Setting in Schenley Park, Pittsburgh

The FOUNDRY Family Photograph Album

Upper Left

STEPHEN BONA

Producto Machine Co., Bridgeport, Conn.

Upper Right

J. B. DEISHER

Columbia Malleable Castings Co., Columbia, Pa.

Lower Left

F. D. CAMPBELL

Eastern Corp., New York

Lower Right

D. L. COLWELL

Stewart Die Casting Corp., Chicago

TENTATIVE SPECIFICATIONS FOR

Copper-base Alloys in Ingot Form for Sand Castings

(*Continued from Data Sheet No.* 834)

5. The chemical analysis shall be made in accordance with the *Standard Methods* of *Chemical Analysis* of *Brass Ingots* and *Sand Castings* (A.S.T.M. Designation: B45) of the American Society for Testing Materials.

6. The designating mark of the manufacturer, the proper lot number, and the numerical designation of the alloy shall be marked on each ingot for identification.

Inspection and Rejection

7. (*a*) Inspection may be made at the manufacturer's works, where the ingots are made, or at the point at which they are received, at the option of the purchaser.

(*b*) If the purchaser elects to have inspection made at the manufacturer's works, the inspector representing the purchaser shall have free entry, at all

Table III—Uses, Manipulation and Characteristics

Alloy	Examples of Use	Foundry Manipulation	Characteristics
No. 1	Commercial bronze for general service	Easily handled	Machines well
No. 2	High-pressure steam fittings	Easily handled	Machines well
No. 3	Steam fittings subjected to moderate pressure	Easily handled	Machines well
No. 4	High-grade red brass for general service	Easily handled	Machines well
No. 5	Reddish-yellow alloy for air, gas and water fittings	Not difficult	Machines easily
No. 6	Valve fittings for low pressure	Not difficult	Machines very easily
No. 7	Bearings for heavy pressure (may later be eliminated in favor of Alloy No. 9)	Not difficult	Machines easily
No. 8	Bearings for heavy pressure (lower cost than Alloy No. 7)	Not difficult	Machines easily
No. 9	General service bearings	Not difficult	Machines easily
No. 10	Bearings operated at high speed and under light or medium pressure	Not difficult	Machines easily
No. 11	Car journal bearings and similar service	Not difficult	Machines easily
No. 12	Yellowish red alloy for plumbers' fittings	Not difficult	Machines easily
No. 13	Yellow brass for light castings and ornamental work not requiring strength or subjected to internal pressure	Not difficult	Machines easily
No. 14	Yellow brass for heavier castings	Not difficult	Machines easily
No. 15	Plumbers' flanges, scupper pipes, etc	Very difficult. Aluminum up to 0.30 per cent improves casting properties, but increases shrinkage.	Hard to machine. Not suitable for bearings or water pressure fittings.

(*Concluded on Data Sheet No.* 836)

TENTATIVE SPECIFICATIONS FOR

Copper-base Alloys in Ingot Form for Sand Castings

(*Concluded from Data Sheet No.* 835)

times while work on the contract of the purchaser is being performed, to all parts of the manufacturer's works which concern the manufacture of the material ordered. The manufacturer shall afford the inspector, without charge, all reasonable facilities to satisfy him that the material is being furnished in accordance with these specifications. All tests and inspection shall be conducted so as not to interfere unnecessarily with the operation of the works.

8. If the test ingots selected to represent a lot fail to conform to the requirements specified in Section 3 all ingots in such lot shall be rejected.

Claims

9. Claims, to be considered, shall be made in writing within 30 days of receipt of material at the purchaser's plant and the results of the purchaser's tests shall be given. The manufacturer shall, within one week of receipt of such claim, either agree to satisfy the claim, or send a representative to the purchaser's plant to resample the shipment in accordance with Section 4. Samples so taken shall be sealed and submitted to a mutually agreeable umpire whose determinations shall be final.

10. The expense of umpire analysis shall be paid by the loser or divided in proportion to the concession made in case of a compromise. In case of rejection being established, the damages shall be limited to the payment of freight both ways by the manufacturer for the substitution of an equivalent weight of ingot metal conforming to these specifications.

Appendix

The data given in Tables II and III do not constitute a part of these specifications. They are given merely to indicate to the purchaser the physical properties of the various alloys specified, that may be expected of carefully manufactured alloys of the formulas indicated and to constitute a guide to the purchaser in selecting the alloy best suited for meeting the service conditions for which the ingot metal is to be used.

THE FOUNDRY DATA SHEET, NOV. 1, 1930
Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

Fundamentals of

FOUNDRY PRACTICE

To Operate a Cupola It Is Necessary To Know the Chemical Composition of the Iron Desired

By Ivan Lamoureux

Interpreted in the Light of American Practice by Pat Dwyer

Part XXI

BY A simple calculation it is possible to arrive at a determination of the proportions of the cast irons on hand or those one desires to obtain. When adding steel to the cupola it should always be borne in mind that this material absorbs carbon from the coke to the extent of about 2.80 per cent. Therefore, it should be considered as an iron with 2.80 per cent of carbon.

Old formulas for mixing gray iron are not applicable except the varieties of iron for which they were established and of which the composition generally is not given. These formulas are only of local interest.

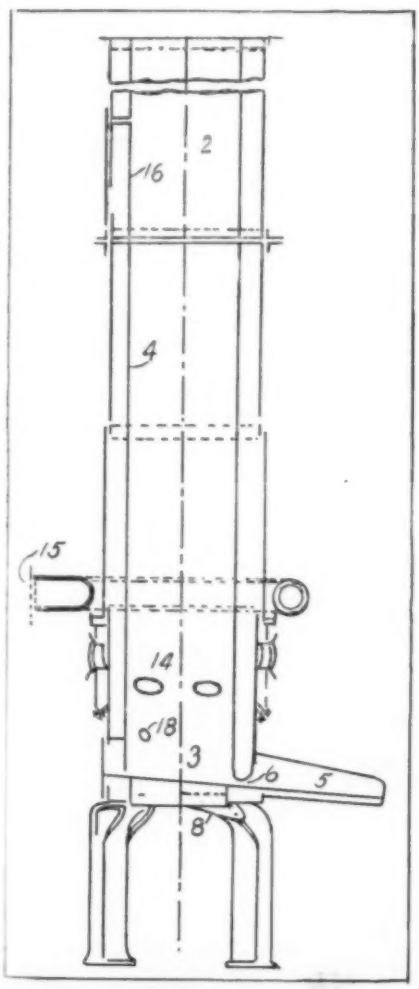
To operate a cupola in accordance with modern methods, it is necessary to know the chemical composition of the iron desired. Table IV shows the composition of a certain number of types of iron, arranged in the order for their silicon content.

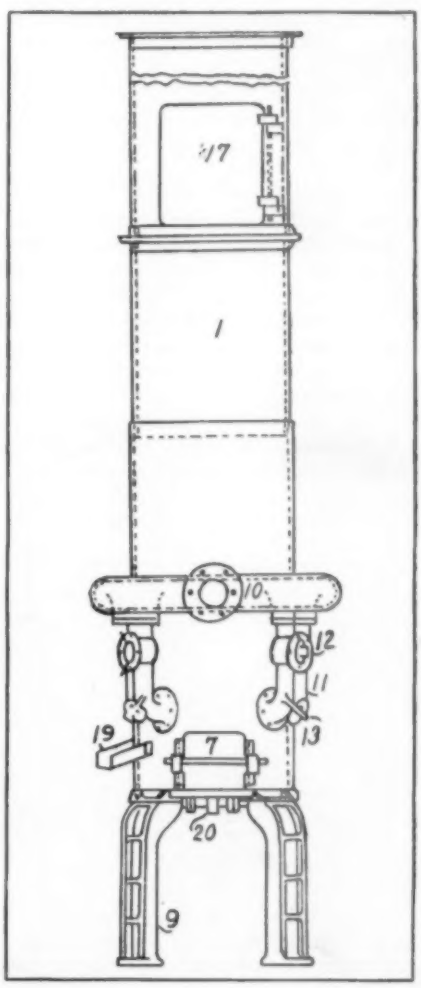
After selecting the type of iron best suited for the purpose, the given contents are increased or decreased in accordance with the anticipated variations occurring in the cupola. The mixture is calculated on a basis which most cheaply will produce the composition wanted. Preparing a mixture is not a question of Scotch iron, hematite, No. 1, 2, or any other. The only point to be considered is the chemical composition.

Table V shows the average dimensions of foundry cupolas. Since its

Cupola Operation

WITH comparatively few exceptions, the cupola is the melting unit employed in gray iron foundries. The basic principles on which the cupola operates and the relative dimensions of the various parts are practically the same in every country. Under favorable operating conditions the cupola is an ideal melting medium, but unless proper care is exercised it is the cause of a great deal of trouble. Intelligent care is required in the preparation of the sand bed, in placing the kindling and coke, in starting the fire, selecting and placing the proper relative amounts of coke, iron and limestone, in regulating the blast and in opening and closing the tap hole. For best results it has been found that the weight of each charge of iron bears a definite relationship—1 to 10—to the melting capacity per hour.





Figs. 256 and 257—Side and Front View of Cupola. The different Parts Are Indicated by Number as Follows: 1—Outer Shell, 2—Stack, 3—Crucible, 4—Lining, 5—Metal Spout, 6—Tap Hole, 7—Back Door, 8—Drop Bottom, 9—Columns, 10—Wind Belt, 11—Tuyeres, 12—Air Valve, 13—Peep Hole, 14—Tuyere Opening, 15—Blast Inlet, 16—Charging Opening, 17—Charging Door, 18—Slag Hole, 19—Slag Spout, 20—Hinges

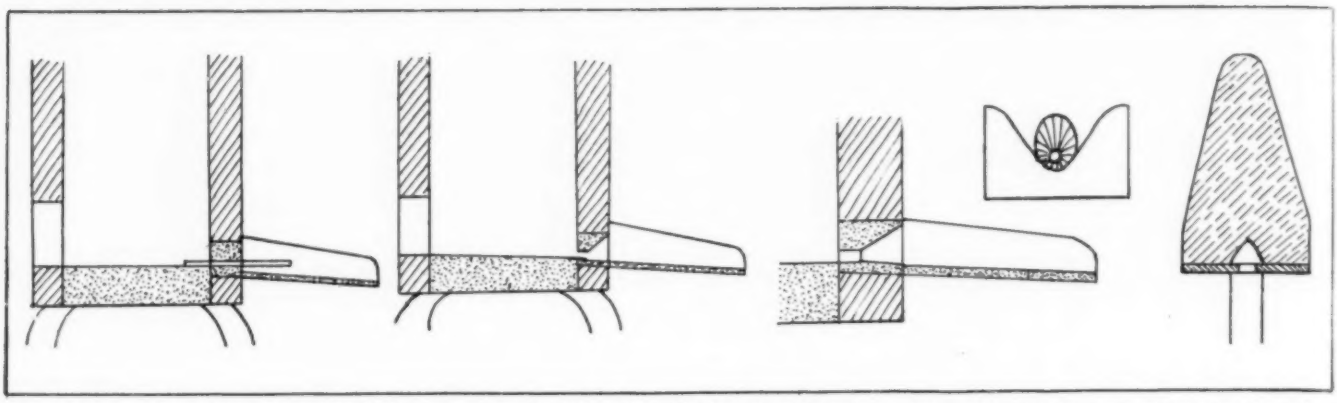


Fig. 258—Sand or Clay Is Packed Around a Rod. Fig. 259—Finished Tap Hole. Fig. 260—Bottom of Spout Is in Line with Bottom of Tap Hole. Fig. 261—Front View of Spout and Tap Hole. Fig. 262—Clay or Sand Bod

invention more than a century ago the foundry cupola has been studied by numerous scientists and inventors. Up to the present no radical changes have been made. This mainly is due to the fact that the cupola as compared to the blast-furnace, is a piece of equipment that works only intermittently. As a matter of fact, the functioning of a cupola during the first half-hour is not quite the same as that during the last half-hour. Consequently before designing or accepting a device to make use of the waste gases one should take into consideration this difference in the course of the operation of the cupola, due to its progressive heating. Many foundrymen believe that a good cupola needs but one row of tuyeres for the following reasons: The melting zone is reduced to a minimum. The quantity of bed coke required is less than for a double row. The wear on the lining is reduced.

Ram the Bottom

In cupolas equipped with the so-called regenerative tuyeres, which transform the carbon monoxide, *CO* into carbon dioxide CO_2 the following advantages are claimed: Absence of useful gases at the charging door, reduced coke consumption and increase in production.

The bottom doors are closed by a prop and sometimes locked with a safety latch. The bottom of the cupola is filled to a depth of 3 to 6 inches with old foundry sand rammed in place and sloped downward slightly toward the tap hole as shown in Fig. 259. The tamping should be done with the greatest of care particularly around the joint to prevent molten metal from leaking out later. The sand is moist as it would be for molding. A smooth, round bar ¾ to 1-inch diameter is placed horizontally along the bottom and projects through the breast to form the tap-hole. The diameter of the tap hole depends on the size of the cupola and the amount of metal.

New fat sand is now rammed around the bar in the tap hole. The sand on the inside is formed flush with the brick lining. A funnel shaped opening is formed on the outside with the tap hole in the center. The rod for forming the tap-hole is worked around to loosen it and then withdrawn, leaving a smooth hole. The cylindrical part of the tap-hole should have a diameter of ¾-inch for small cupolas and 1-inch for large ones. The length of this same part varies from 2 to 3 inches.

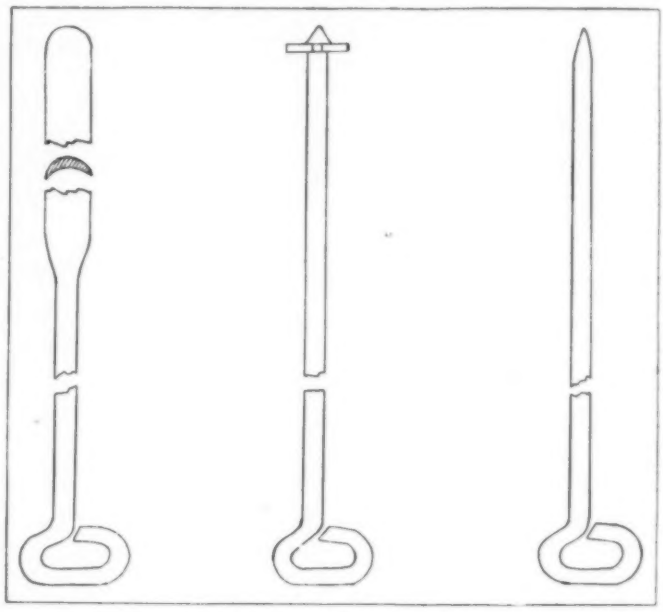


Fig. 263, 264 and 265—Tools Which Are Employed in Opening and Closing the Tap Hole

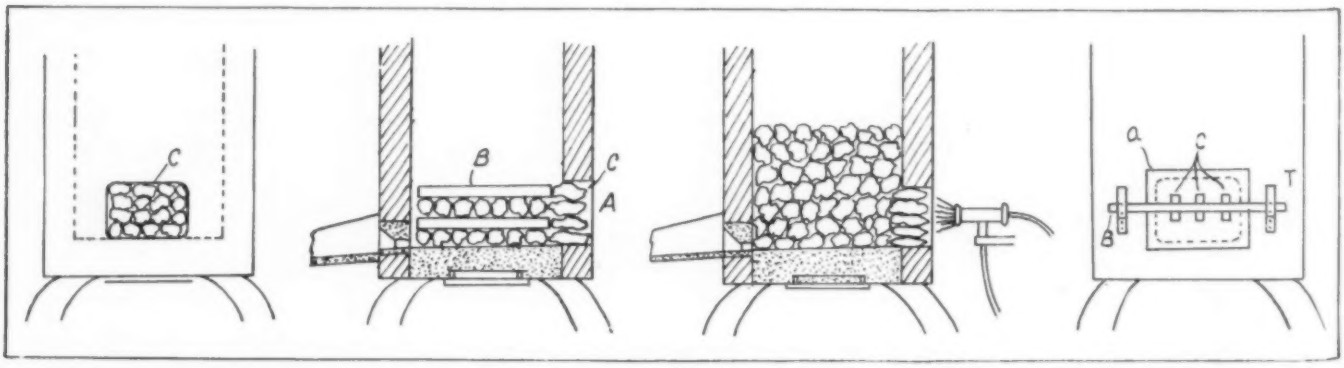


Fig. 266—Wood, B, Is Placed on the Bottom to Start the Fire and Lumps of Coke, C, Are Packed in the Fire Door A. Fig. 267—An Oil Burner Is Employed to Light the Coke. Fig. 268—Firing Door Is Clamped in Place Before Melting Commences

These various features are shown in Fig. 259.

The pouring spout should have a slope of approximately 8 per cent, or 1-inch to the foot. It is lined with new fat sand rammed in place and in such a manner that the bottom of the trough forms a straight line with the bottom of the tap hole as shown in Fig. 260. A sectional view of the trough should be as shown in Fig. 261 which compels the metal to follow the hollow without any twisting. The edge of the spout is moistened by a brush dipped either in clean or clay water to make the sand stick without cracking or crumbling. Spouts on large cupolas are lined with brick and are covered with a thin coating of clay and blackwash before the heat.

Stop the Stream

To plug the cupola, a stopper or bod of very fat sand is prepared beforehand which permits stopping the flow of metal without danger and without a hitch or hindrance. In European foundries fat sand is mixed with loam molding dust, tan bark and horse-manure. American foundrymen use clay almost exclusively, any kind of clay. The clay is dampened with water and kneaded into a homogenous mass. It is made up into conical plugs as shown in Fig. 262, prepared in advance.

For a cupola of 1 to 2 tons capacity the bod should have a diameter of 1½ inches, the same size as the disk on the end of the bodiron. The length should be 2½ inches. For a 5 to 6 ton cupola the bod will have a diameter of 1¾ inches and a length of 3 inches. The clay for making the bods is kept covered in a metal can with a piece of moist canvas outside of casting hours. It can be kept thus for several days.

A set of tapping and stopping tools, whose dimensions conform to the size of the cupola is indispensable. It is advisable to have on hand short and long tools for each cupola and thus be prepared to cope with any emergency that might come up.

Sometimes the man misses with the bod and the metal continues to run out, over-runs the ladle and spreads over the ground. The cupola tender cannot get anywhere near the tap hole and the stopping must be done at some distance. The same applies to tapping. If there is a large ladle under the spout, so much heat is radiated that the cupola man has to stand at quite some distance from the spout. On large cupolas the attendant stands on a platform at one side and close to the spout. He uses short-tapping and stopping tools.

A wood fire usually is built on the bottom of the cupola. The fire door at the back is left open. American cupolas are not equipped with this door. The wood is piled up to a height of 10 or 15 inches. Large, dry pieces are selected so that they will not burn away too fast before the coke is ignited properly. The tuyeres are closed. A wall of coke, Fig. 266, is laid up in the opening of the fire-door, consisting of fairly long pieces of coke as uniform in section as possible.

The wood is ignited by a red hot iron poked through between the pieces of coke. After a few minutes the cupola is filled with coke, through the charging door, up to a height of 15 to 18 inches. After the coke has caught fire and no more smoke is produced from the combustion of the wood, the cupola is filled with coke up to the level of the tuyeres. After about ½ or ¾ hour, the fire reaches up to the tuyeres and coke is added to form the bed to the height required for charging the iron.

When the fire appears bright as viewed through the peep holes in the tuyeres, the fire door is closed. The height of the coke above the tuyeres, varies according to the diameter of the cupola. Generally a height above the tuyeres equal to the diameter of the cupola is adopted. Manifestly this rule only applies to small cupolas. From 24 to 30 inches is accepted as the proper height for a coke bed in any cupola, irrespective of the diameter.

Where compressed air is available, it is advisable to employ an oil burner to start the fire in the cupola. The burner serves also to preheat the crucible and the lining of the ladles.

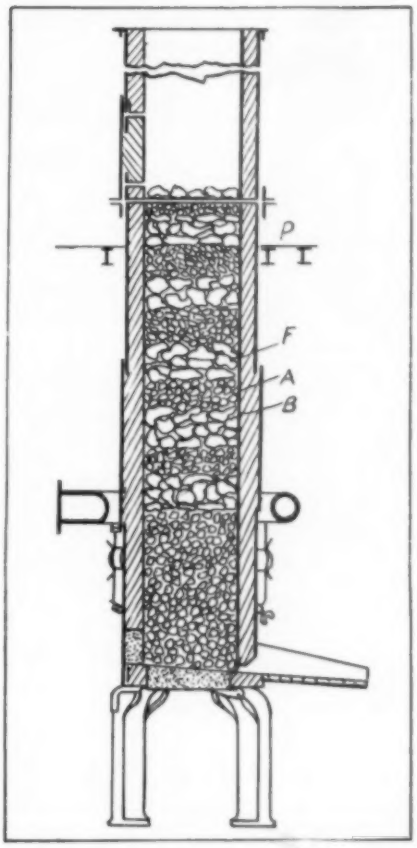


Fig. 269—Sectional View of Charged Cupola

The required amount of coke is put into the cupola, after the small coke wall is built in the fire door opening. The burner is placed facing the door and the coke is ignited in a few minutes. As the bottom is not heated, care is taken to direct the burner flame toward the bottom of the cupola as in Fig. 267. One is sure then of having hot iron at the start.

Lock the Door

In the majority of cases the fire door consists of an arched metal plate held in place by an iron bar pressed between two fixed clamps and tightened by several iron wedges as illustrated in Fig. 268. This arrangement has the disadvantage of tearing the outside shell of the cupola on account of driving in the wedges with hammer blows. A better result is obtained by having two pieces riveted to the shell on each side as in Fig. 270. The iron cross-piece is provided with two locking screws, which are better than the ordinary wedges.

Another device, an old one, designed by Jos. Lamoureux in 1880, and shown in Fig. 271 consists of a cast iron plate attached at an angle to the shell of the cupola. After the plate is put in place, sand is rammed against the coke and there is the absolute certainty that no iron will leak out. The plate is pierced in one place for a slag hole.

In the first two cases illustrated, the sand has to be tamped with con-

Table IV

Compositions of Various Cast Irons

Kind of casting	Silicon	Manganese	Phosphorus	Sulphur
Fluid and thin iron	3.25	Low	up to 1.05	Low
Fine appearance	2.40 to 3.00	1.00	up to 1.05	0.10
Mechanical softness	2.20 to 2.80	0.70	up to 0.70	0.08
Stove plate, sewing machine parts	2.30 to 2.50	Low	up to 1.00	Low
Automobile cylinders	2.25	0.50	up to 1.00	0.075
Small machine parts	2.00	0.40	up to 0.60	0.04
Ingot molds	1.70	0.30	up to 0.10	0.03
Average iron	1.40 to 2.00	0.70	up to 0.70	0.085
Subject to pulling stresses	1.50	1.00	up to 0.50	0.07
Subject to impact stresses	1.50	1.60	Low	Low
Steam cylinders	1.40	0.70	up to 0.70	0.09
Hard iron	1.20 to 1.60	0.70	up to 0.70	0.10
Rolls	0.85	1.00	up to 0.70	Low
Heavy compression	0.80	0.30	Low	Low
Chilled iron	0.80	1.50	Low	Low
Hard iron for heavy castings	0.50 to 1.00	0.50 to 1.00	up to 0.30	Low

Table V

Characteristics of Cupolas

DIMENSIONS

Melt per Hour Tons	Lining Inches	Shell Inches	Legs Inches	Height Feet	Stack Feet
1	20	30	36	8.4	8
1½	24	34	36	10.0	10
2½	26	36	36	11.5	10
3½	30	40	36	15.0	10
5	36	46	40	16.6	10
6	40	50	40	16.6	10
8	42	52	40	18.0	10

siderable care and then the operator must make sure that the arched plate bears evenly all around. He may have to put on more sand or take some off and then he has to fasten the plate in place by wedges or bolts. After the fire door is closed the tuyeres should be opened.

As soon as the coke bed burns through, charging should be started. The height of the coke bed may be checked by a bent rod or by a measured piece of wire to which a small piece of iron is attached for a weight. The weight is let down until the mark on the wire comes level with the edge of the charging door. Then the charge is put in, first the iron, then the limestone and the coke. This order is repeated as often as necessary to make up the amount required for the day.

Change the Cupola

Usually the weight of the charge is set at one-tenth of the hourly production. For example, for a 2-ton per hour cupola, each iron charge will be 400 pounds and for a 5-ton cupola the charge would be 1000 pounds. It is desirable not to make the charges too heavy, otherwise the melting zone would be too high and would thus heavily damage the refractory lining.

As a general rule, the weight of the coke charge amounts to 10 per cent of the iron charge. When melting steel, the quantity of coke consumed is much greater. When melting thin scrap or pieces of pigs broken in small pieces, the percentage will decrease. The quantity of coke consumed also is influenced by its quality, that is, according to whether it is high or low in ash content, the size of the pieces fed into the cupola and the nature of the metal. For example, white cast iron melts much easier than soft iron.

On an average the weight of the limestone should amount to 35 per cent of the weight of the coke. The actual amount of limestone will be influenced by the quality of the coke, the more ash it contains the more limestone will be required. If burnt iron or scrap iron covered with dirt and oil is used, the amount of limestone will have to be increased.

After the cupola has been charged with the required quantity of firing coke, the first charge of iron is added. The pieces of pig iron or scrap should not be thrown too violently against the walls of the cupola which ordinarily have just been repaired. Limestone usually is handled with a shovel and the coke is forked. The foregoing refers of course to cupolas that are not equipped with mechanical charging devices.

The coke should be charged just as it comes, that is partly in large and partly in small pieces. It is a grave mistake to break the coke before putting it into the cupola. It burns faster when in small pieces and does not fully accomplish its purpose. Part of the coke serves to melt the iron and the other serves to maintain the firing or bed coke at a uniform level. Large pieces of coke are not entirely consumed after having passed the melting zone which always stays nearly at the same place. The charging is continued in the order indicated coke, iron, limestone, up to the level of the charging door as indicated in Fig. 269.

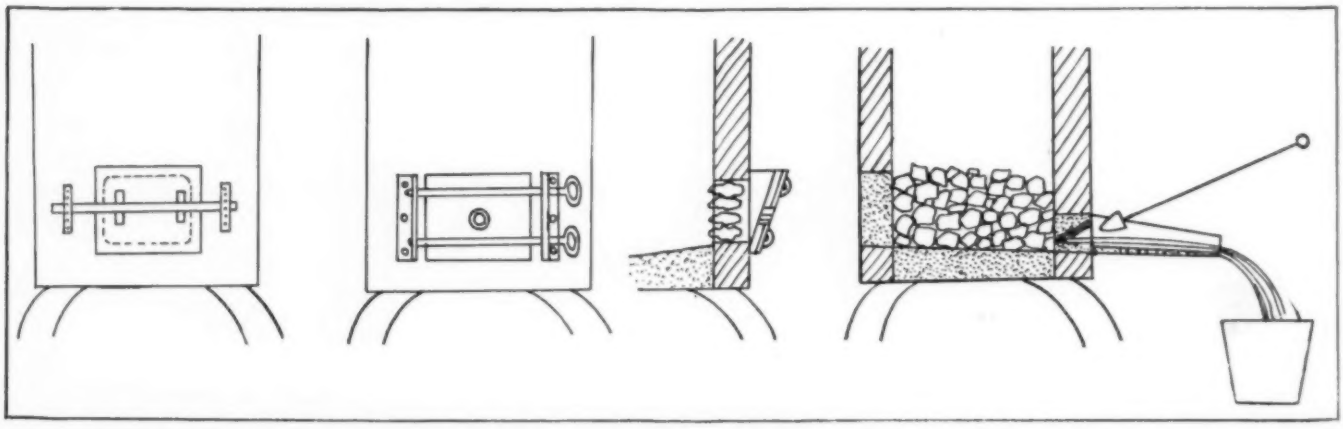
Before putting on the blast, the foundry term for starting the blower, the tap-hole is closed with a small lump of moistened old sand tamped in by a hammer handle. A piece of stock core may be employed for the same purpose. The slag-hole is closed in the same manner. The blower is started and the peep holes on the tuyeres are closed.

If the cupola is properly fired, the first drops of melted metal should be noticed in a few minutes dropping down past the tuyeres. Normally it should be possible to tap the first iron in 20 minutes. Obviously this depends on the kind of castings to be poured and on the holding capacity of the cupola crucible. Immediately after melting commences, the entire charge begins to descend. Additional coke, iron and limestone are introduced at the charging door until the total quantity necessary has been put in.

Poke the Tuyeres

If the coke in front of a tuyere becomes black, the air blast immediately is cut off from it to impede the action in the vicinity. From that moment the opposite tuyere sends a blast across the incandescent zone of fuel and acts as a blow-pipe. The flame burns the black material in front of the tuyere which generally is nothing more than a piece of slag easily removable. Although not universally practiced, the value of a shut-off gate or valve at each tuyere, is readily apparent.

Poking the coke through the tuyeres should be prohibited absolutely. This practice interferes with the proper functioning of the cupola. The wind pressure drops immediately. The black portion consisting generally of a piece of cold slag is pushed into the crucible of the cupola which it fouls up in an absolutely detrimental manner. In cupola practice, just as in many other lines, sometimes it is necessary



Figs. 270 and 271—Alternative Methods of Fastening Firing Door. Fig. 272—Proper Method of Inserting Rod in Tap Hole

to combat established habit. The best way to become convinced of the advantage of keeping tuyeres closed, is to try it.

It is not advisable to leave the tap hole open at the beginning of the heat as it causes a flow of air across the bed coke. The blast follows the same course as the first melted iron and oxidizes it to an excess. This makes it harder and more pasty and extremely hard to tap. The first melted iron does not run readily over the bottom. It is cold when it reaches the tap-hole and forms a metal plug which can be removed only after hard work.

If the tap-hole is closed with a lump of old sand, the first iron melted accumulates on the bottom against the sand plug. As the bottom has been strongly heated while the fire door remained open and the fire was burning strongly, the iron remains thoroughly heated and fluid. A slight tap with the tapping bar releases the sand plug and is enough to start the metal flowing out immediately.

As soon as enough metal has been drawn off or the crucible is empty, the stopping bod is pushed in the tap-hole as indicated in Fig. 272. The bod enters at an oblique angle, cutting the stream of metal at a sharp angle from top to bottom. Nothing is more dangerous than to push the bod directly against the stream of iron. It will cause an explosion and scatter metal all over the breast of the cupola.

Before tapping the second, and each succeeding time, care should be taken to remove anything that may be left in the tap-hole from the previous stopping, such as burrs, spattered iron, slag, etc. If this precaution is not observed, the tap-hole after a few stoppings becomes plugged entirely. It loses its clean straight form and presents a real difficulty in stopping it properly.

Sometimes the descent of the charge is obstructed by roughness in the cupola caused by the destruction of the refractory lining, or on account of a long pig or piece of scrap iron becoming jammed. This condition makes itself evident immediately by the top charge remaining stationary. The offending piece usually may be dislodged with a long bar inserted at the charging door. It will be necessary to put in an additional charge of coke before putting in any iron. While the charge of iron in hung up, the coke below it will burn away at a loss. Therefore, it will be necessary to re-establish the original level of the bed by new additions of coke thrown in through the charging door.

Plan Reduction in Foundry Accidents

ACTIVE programs in accident prevention among foundries in the United States fail to find true reflection in the safety record of the foundry industry, it was disclosed at a session on foundry safety held at Pittsburgh, Oct. 1, as part of the nineteenth annual congress of the National Safety council. Both frequency and severity of accidents increased last year and were higher than in 1928 or 1927. With the exception of the structural steel fabricating group the record of the foundry industry in 1929 was the poorest of the ten divisions of the metals section.

The foundry session brought out considerable discussion regarding methods of correcting this unfavorable situation. It was pointed out by several speakers that although the safety movement is installed solidly in the majority of the larger foundries, many small companies have made no concerted effort to reduce accidents. This has reacted to the detriment of the record for the industry in general.

The frequency rates of accidents among steel, gray iron and malleable iron foundries last year were 51.14, 52.37 and 59.91, respectively, against 40.03, 52.42 and 61.66 in 1928. Those figures compare with an average of 22.64 for the entire metals section for 1929 and 23.90 the preceding year. The severity rates of the three foundry groups were 2.47, 2.14 and 1.76 compared with 1.58, 1.34 and 1.76 the preceding year. The average for the metals section increased from 1.68 to 2.15.

A program for furthering safety work which has passed through two stages, the guarding of machines and education in safety, was proposed by J. W. Beall, Ohio Steel Foundry Co., Lima, O., in a paper on "Foundry Engineering and Safety." His program seeks the purposeful elimination of misguiding sentimentalism from accident prevention safety program work, the charging of accidents costs along with overhead and production costs to the department where accidents are permitted to occur, and the use of discipline in enforcing safety measures.

Considerable discussion developed on experiences of various foundries in use of protective devices for hands, feet and head. In a paper on this subject, S. W. Doran, personnel superintendent, Pratt & Letchworth Co., Buffalo, pointed out that flask handling is responsible for many hand accidents and is one of the local points of attack in the elimination of such injuries. A thorough understanding of signals for the movement of cranes was stated as important in overcoming this hazard Faulty hooking was charged with chief responsibility for most falling objects. Careless piling of castings and equipment also causes many foot injuries.

Use Safety Devices

Lax enforcement of rules governing wearing of goggles and the use of welding goggles for chipping work were blamed for eye injuries. Improved guarding of grinding equipment has reduced the eye hazard considerably, it was stated, but often is offset by careless use of goggles. Opinion on the use of goggles in pouring metal differed. Some foundry representatives reported success in their employment and others stated that the glass became fogged so easily that it created a hazard. Difficulty in forcing employes to wear goggles has been overcome at some plants by layoffs for initial offences and discharge for repeated violations of the rule. Reports indicated a steady increase in the compulsory use of safety shoes.

F. G. Bennett, safety director, Buckeye Steel Castings Co., Columbus, O., presided at the session.

H. G. Hensel, Youngstown Sheet & Tube Co., Chicago, was named general chairman of the metals section for the coming year at the annual election. Other officers chosen were: Vice chairman, Frank Lauerman, Republic Steel Corp., Youngstown, O.; secretary and news-letter editor, R. L. Schmitt, Louisville Car Wheel & Railway Supply Co., Louisville, Ky. Carl W. Bergquist, superintendent of public relations, Western Electric Co., Chicago, and for the past year vice president in charge of finance of the National Safety council, was selected to head the society for the coming year. Frank J. Lanahan, president, Fort Pitt Malleable Iron Co., McKeesport, Pa., was appointed to the executive committee of the council.

Awards were presented to ten plants who were winners in their respective divisions in the annual safety contest of the metals section. United States Pipe & Foundry Co., Scottdale, Pa., was the winner in the iron foundry division of plants employing 500 and more men, while the United States Radiator Corp., Edwardsville, Ill., plant, received the plaque for iron foundries employing from 30 to 500 men. Awards in the steel foundry division went to the Pratt & Letchworth Co., Buffalo, and the American Rolling Mill Co., Central works, Middletown, O.

The regular October meeting of the Detroit Foundrymen's association was held Oct. 16, at the Fort Shelby hotel, Detroit. Program for the meeting consisted of a continuation of the discussion of the American Foundrymen's association tentative recommendations for the operation of a 54-inch cupola.

Questions & Answers on FOUNDRY PRACTICE

GRAY IRON

Hardness Not Indicated

QUESTION

Recently we made a semisteel gear 60¾ inches in diameter and weighing 3100 pounds. The face was 12 inches wide, with a rim 2½ inches thick which contained 118 teeth. The gear had 6 arms and a hub 15 inches deep, 23 inches outside diameter and 13½ inches inside diameter. It is claimed that the metal in the gear is too soft, based upon the following analysis: Silicon, 1.99 per cent; sulphur, 0.076 per cent; manganese, 0.66 per cent; phosphorus, 0.24 per cent; chromium, 0.23 per cent; nickel, 0.18 per cent; combined carbon, 0.48 per cent, and graphitic carbon, 2.65 per cent. Do you think that that analysis is too soft for the gear in question?

ANSWER

It is not always safe to judge hardness and mechanical properties of a casting from analysis alone. Much depends upon the melting process employed. If the cupola is used, heat of the iron has some effect; also the amount of steel scrap used. Special melting practice often produces improved results from a given analysis. A few examples may be of value. In making gears of the type mentioned, one large machine tool maker uses a 25 per cent steel scrap mixture which shows 1.30 per cent silicon and 3.30 per cent total carbon in the test bar, and produces excellent metal. A large manufacturer of paper mill machinery uses a 15 per cent steel scrap mixture which gives 1.20 per cent silicon and 3.45 per cent total carbon in the test bar. Gears faces are blank and are chilled. Teeth are cut and the gears drive large dryer rolls.

Another manufacturer using a special process can produce metal for such sections with superior physical properties with an analysis of approximately 2.50 per cent silicon and 2.90 per cent total carbon in the test bar. The term *carbon in the test bar* is used purposely because for some unknown reason, the carbon in the test bar generally runs about 0.10 to 0.25 per cent higher than that obtained in analysis of large castings. For example, your analysis which undoubtedly was not made by the direct combustion of carbon, indicates 3.13 per cent total carbon. If the carbon was determined by combustion from a sample taken from a test bar, and you were using 25 per cent or over steel scrap in the cupola mixture, your iron might be reasonably hard for the purpose.

However, if the sample were taken from the casting, and little steel scrap was used, the iron may be in the 2.00 per cent silicon, 3.50 per cent total carbon range which would give a poor metal for heavy sections. You can obtain the brinell hardness of the casting with a portable brinell meter. If the brinell hardness number is 170 or above, the metal is reasonably hard. To avoid trouble in the future we suggest you arrange a definite specification with the customer. Also if the cupola process is used, add 25 per cent steel scrap to the mixture and reduce the silicon to 1.25 to 1.50 per cent. Keep the total carbon below 3.30 per cent by maintaining light coke splits, proper air volume and plenty of return scrap.

THIS department covers all problems relating to metallurgical, melting and molding practice encountered in making steel, malleable-iron and gray-iron castings. Questions submitted by bonafide subscribers to this department will be answered by members of the editorial staff of The Foundry, supplemented where occasion requires by the advisory staff whose personnel is as follows:

John H. Hall
Cast Steel

H. A. Schwartz
Malleable Cast Iron

J. W. Bolton
Gray Cast Iron

All questions should be addressed to the Editor, The Foundry, Penton Building, Cleveland.

Q & A

Gray Iron Annealing

QUESTION

We are contemplating the possibility of annealing thin gray iron castings which become chilled from the permanent molds in which they are cast. Have you any data on the subject, and are there any books relating to the manufacture of thin gray iron castings in permanent molds and their annealing?

ANSWER

There are no books dealing exclusively with the manufacture of permanent mold castings, or their annealing. A number of articles have been published at various times on the subject including several in the *Transactions* of the American Foundrymen's association, 1926. Use of metal molds is not a new process, but due to lack of proper refractories not much progress was made until recent years.

Several methods of coating the interiors of the metal molds have been employed. In one method the surface was impregnated with metallic zinc. In another the surfaces are smoked with luminous flames, and a third method is the use of a refractory clay suspended in sodium silicate which is painted on the surface and then dried. Some of the methods mentioned are patented and it is suggested that you investigate that phase before proceeding.

Iron poured into a metal mold usually is cooled much more rapidly than when poured into a sand mold. If the chilling action is rapid and silicon content low, a white fracture iron results. Conversely, if iron is poured at a suitable temperature into a hot mold with a low heat conductivity refractory lining, a gray or self

annealed iron may be obtained if the silicon is high. If the fracture of the iron is white, annealing temperature may have to be around 1700 to 1750 degrees Fahr. With a mottled fracture indicating partial graphitization, an anneal of 1550 degrees Fahr. for 15 minutes or more depending upon the section size of the casting, perhaps will be sufficient to produce a gray fracture.

In all annealing practice, rapid heating up or quick cooling of castings is likely to cause cracks. Therefore, close attention must be paid to those phases. An iron low in silicon and carbon like malleable cast iron, is difficult to anneal as both higher temperature and considerably more time are required than for high silicon, high carbon iron. Small percentages of chromium also will cause difficulty in annealing.

Q & A

Uses Cast Iron Borings

QUESTION

We have a quantity of machine shop borings which we would like to melt in our cupola. We make builders' hardware, jobbing work, locks, and other light castings. How far can we go without getting into trouble? Our cupola is lined to 32 inches and we cast about three tons per day. The heats last about an hour and the iron must be hot and soft. We are charging half pig and half scrap on the first of the heat and gates and sprues on the remainder. The charges weigh 1200 pounds.

ANSWER

Probably the easiest way for you to handle your borings will be to put them into sheet iron tubes with metal disks forming the ends. The ends of the tubes may be crimped over to hold the disks in place. The borings should be rammed by hand or jolted in the tube so as to compress them as much as possible. Since your cupola is small we suggest 1-foot lengths of 5-inch stove pipe. These, with the borings well-packed in, will weigh about 20 pounds.

It is difficult to say just how much borings you can use without being troubled with hard iron. Therefore, you will have to experiment until you find the limiting amount of borings to use. Try one tube per charge and note the effect. If everything turns out satisfactorily, try two, and so on till the iron begin to show hard. This will be the extreme quantity that you can use without too much difficulty.

We note that you are using 1200-pound charges of iron. We believe that you will get hotter iron by decreasing your charges to 700 pounds. Use about 70 pounds of coke between charges and start with a bed 30 inches above the tops of the tuyeres. Also with the borings you undoubtedly will have to use pig iron in every charge to provide those elements such as silicon and manganese that may be lost during the melting of the borings.

GENERAL

Gating Causes Trouble

QUESTION

We are making some blank gears 10 inches in diameter with a 16-inch face and 1½-inch bore. The bored hole, face and bottom, of the finished casting is free from any defects, but the cope side of the casting shows porous metal. The heads are fed using a rod to keep them open, and when broken off show no shrinks. The iron used has the following analysis: Silicon, 1.56 per cent; sulphur, 0.045 per cent; phosphorus, 0.294 per cent; manganese, 0.79 per cent; chromium, 0.17 per cent, and nickel, 0.06 per cent. Fifteen per cent steel is used in all charges. Many of our other castings also are showing defects on the cope side.

ANSWER

Your difficulties are caused by improper feeding. To obtain good results it is necessary that the iron be melted rapidly and hot. It also will have to be poured at a higher temperature so that it possesses the necessary fluidity. Heavier risers or heads must be used to supply additional metal as the first metal begins to solidify and contract. Therefore, we suggest that the size of the heads be increased to 2 or 2½ inches in diameter at the casting and placed directly above the gear. In feeding see that metal used is hot. Also see that you have a good head of metal in the sprues and risers which should extend at least 6 inches above the highest part of the casting. If the cope is not deep enough, the sprues and risers may be bushed to give the necessary height. Try changing your methods of gating on your other castings also.

Q & A

Small Cores Easily Made

QUESTION

I have a small foundry in which I make plow parts and general repairs for many kinds of small machinery. Occasionally I need to use a core, but I am totally unfamiliar with the materials or method of preparation. I shall appreciate any information you can give me on the subject.

ANSWER

Coremaking is a branch of the molder's trade that presents an almost infinite variety in combinations of materials and methods of preparation. In your particular instance where it is assumed the cores are small and plain, all you need is a supply of sharp sand and a quantity of a suitable binder. The sharp sand is known under a variety of names in different sections of the country and among men who require it for various uses. Thus it is referred to as sea sand, river sand, bank sand, fire sand, washed sand and builder's sand. It is a clean sand with grains of fairly uniform size, without any bonding material. When it is dried it will run freely through an opening or down an incline. It is used by locomotive drivers and street car men to secure traction on wet and slippery rails. It is available in a natural state nearly every place and probably is the cheapest, bulk for bulk, of any material used in the foundry.

A large variety materials that will mix with sand and that will evaporate in the oven and leave a film to bind the grains of sand together, may be employed as binding agents. Certain materials are more suitable than others to meet specific conditions. In many instances the difference in price between the materials landed in the foundryman's yard, is the only factor which decides him in his choice. You can order any of the core binders from the foundry supply houses listed in the advertising of THE FOUNDRY. These houses also will give you the formulas for typical core sand mixtures for various sizes and shapes of castings in various metals.

Q & A

Makes Sash Weights

QUESTION

Part of our foundry floor space is not being utilized at present and we are contemplating the manufacture of window sashweights. Can you give us some information on how these castings are made?

ANSWER

At various times detailed descriptions of many methods for molding sashweights have appeared in THE FOUNDRY. If you have access to back files we suggest that you consult the March 15, April 1, April 15, May 1, May 15, June 1, and June 15, 1924 issues which contained a series of articles dealing with the subject. Briefly and in a general way it may be stated that the best and most economical method for molding these castings depends upon the volume of business.

In one method the castings may be made from matchplate patterns on which the split patterns are attached on opposite sides of the board. A second method that affords greater flexibility, whole patterns are submerged half way in a follow board. In this method one follow board will serve for various lengths by placing fill-in pieces at the ends of the shorter patterns. The job lends itself readily to production either on a plain jolt or squeezer type molding machine, and we suggest that you get in touch with the various molding machine manufacturers listed in the advertising section of THE FOUNDRY for estimates to meet your particular condition.

According to a third method two groups of patterns are rammed alternately above each other horizontally in a deep flask holding six or eight

groups until the flask is filled. The patterns are drawn horizontally through openings in the end of the flask and the openings are closed by suitable plugs either of iron or core sand that form the eyes. In a fourth method a battery of patterns is mounted vertically on a stripping plate frame and utilized in connection with a jolt ram machine. The patterns are mounted in such a manner that any desired length of casting may be secured by adjusting the patterns at a definite height above the plate. In some foundries a flat cope is employed and the eye in each casting is formed by dropping a suitable core to the bottom of each mold. In other foundries the cope is rammed in a suitable pattern plate in which wire loops are placed. When the cope is removed the upper part of each loop remains bedded in the sand and the projecting toes enter the mold where later they are surrounded by molten iron. Sash weights also are made in permanent iron molds which are cooled by air or water. One half of the mold is stationary and the other half is arranged so that it can be swung away from the stationary part. The locking or clamping device is of simple construction so that the mold may be opened or closed easily.

Q & A

Core Does Not Stand Up

QUESTION

We are having trouble with a small air-cooled cylinder. The mold is made on a machine and afterward dried in the oven. The thin cores between the vanes appear to cut and the dirt floats into the body of the casting. Do you know of any special oil sand core mixture for making these castings?

ANSWER

These castings are made extensively in many places in oil sand cores and apparently do not give any trouble. We are inclined to the opinion that your oil sand core contains more or less molding sand and therein lies the cause of your difficulty. Unless the sand vanes are extremely porous the gas cannot escape quickly enough and as a result it sets up a commotion that dislodges some of the sand and causes it to float away and lodge elsewhere. On account of the fragile character of the cores, the coremaker is tempted to use molding sand in the mixture to give it a body and hold it in shape while in the green state. The molding sand reduces the permeability of the mixture and prevents the rapid escape of the gas when the sand vanes of the core are surrounded by molten iron. In some instances a small amount of a cereal binder is added with the oil.

A possibility exists that you are using a natural bonded sand on the assumption that because it is satisfactory for many other small cores, it should be satisfactory for these intricate cylinder cores. A sand of that kind is not sufficiently permeable in this particular instance. If you use a fine, clean sharp sand bonded with a minimum amount of oil, you should have no further trouble. Also see that the backing sand behind the cores is open so that any gases generated may be removed rapidly.

Q & A

Stack Green Sand Molds

QUESTION

We are seeking information on how to cast automobile piston rings individually. We are familiar with the usual method in which the rings are cut from cast iron tubes, but we have been told there is a method by which the rings are cast as units. Is this a die casting method, or, are the castings made in sand molds? If they are made in sand we shall appreciate particulars on the equipment and methods employed.

ANSWER

Attempts have been made several times to cast individual piston rings in permanent molds, both stationary and spinning, but so far as our knowledge extends to foundries in this country, without success. According to an article published in THE FOUNDRY March 15, 1922, a prominent British firm was casting tubes centrifugally from which piston rings afterward were cut.

Individual piston ring castings are molded extensively in green sand in snap flask molds made on squeezer machines. The metal patterns are arranged in a double row on a matchplate with a long runner in the center. The molds are stacked for pouring and each mold section serves as a cope for one mold and a drag for the next one above. A central sprue passing through the stack feeds metal to the various cavities.

MALLEABLE

Plates Are Made Easily

QUESTION

Some time ago we inquired about the use of wires as cores in 3/16 and ¼-inch malleable cast iron wing nuts, and you suggested using patterns that would leave their own cores in the green sand mold, or small dry-sand cores. We find that the green sand core is satisfactory, but the method does not work when customers want their initials on the wings. Is the method of leaving the cores practicable with 5/16, ⅜ and ½-inch nuts? In the case of the dry sand cores do you know of a machine that will turn out such cores cheaper than the gang boxes particularly in the small sizes mentioned? You also referred to a pattern plate of wing nuts. How would such a plate be made? We are not equipped with hydraulic power or compressed air.

ANSWER

From your reference to the initials on the wings of the nuts, we assume that such wing nuts must be molded on their sides, an in such cases it is not so practicable to leave a green sand core although it could be done with some extra manipulations and special pattern plates. However, the latter method probably would not pay in the case of the small cores and castings. The dry sand core will be the logical thing to use. While we cannot state definitely that the method of molding the wing nuts upright and leaving their own cores will work on all sizes, we believe that the larger the core desired, the easier it will be. That is simple reasoning, because the larger the body of sand, the less likelihood of disturbing it when the pattern is lifted.

Use of gang boxes for producing the cores probably is the quickest method. As far as we are aware, extrusion-type core machines do not make cores smaller than ⅜-inch in diameter. While you do not state your present method of molding the wing nuts, we assume that you are using a number of the wing nuts joined together in some manner which are laid upon a follow board to form the pattern. If such is the case it will be an easy matter to make a pattern plate of wing-nuts. Add some strips around the edges of the follow board so that it is about 4 inches larger in each dimension than the flask to be used later in production work. Then center the flask on the board. The flask should be large enough to allow sufficient space around the edges of the plate to be produced, for the location of lugs for the flask pins. Then proceed in the regular manner for making a half mold of wing nuts. After ramming the mold, strike off the excess sand, and throw on a litle loose sand. Rub a smooth bottom board in place, clamp it and roll the whole over. Remove the follow board which now is on top, and ram up the cope. Then lift off the cope and carefully take out the patterns of wing nuts without disturbing the sand.

Cut the necessary gates or branch gates that will enable the metal to fill the various cavities rapidly and completely. Then place strips along the four sides of the flasks. The strips may be brass or other metal about ½-inch wide and 3/16-inch thick. The space formed inside the sand strips should be the dimensions desired for the finished plate allowing of course, additional space at the points where lugs for flasks pins will be located. Cover with the cope half previously mentioned which contains the required sprues and risers for aluminum, iron, other metal as desired. These, of course, are placed along the edges of the plate so that they may be removed easily.

This is one method of making a matchplate. However, there are several ways of doing the work and we suggest that you study those methods presented in *Tales from the Gangway*, by Pat Dwyer which may be obtained from THE FOUNDRY.

Problems in Nonferrous Founding

By Charles Vickers

Molding Methods Given

In molding pattern plates of aluminum we request the following information: What kind of sand is used? Is the mold faced and if so, what kind of facing is used? Is the mold skin-dried, baked, or made in green sand? What alloy is used and what is the best pouring temperature? Is it necessary to use risers on the sides and ends of castings? What size risers would be necessary for a 10 x 16 inch plate of usual thickness? Is it necessary to use more than one crucible in pouring a mold when the contents of one would be sufficient? Is there any way to fill in the draws or cracks in aluminum pattern plates while they are hot?

Replies to your inquiries will be given in the order asked. A fine grade of aluminum or brass sand is used. It should have maximum permeability, so the aluminum will lie quietly and not dance or simmer before congealing. Sands specially adapted for match plate molding can be bought from the supply houses. With the proper sand, no facing is necessary. Whether the mold is skin-dried, baked or is cast green will depend on the pattern being molded. Common sense must govern combined with good judgment. An alloy containing silicon is best. Special alloys have been developed for the purpose, and can be purchased. The pouring temperature of all aluminum alloys should be as low as possible, consistent with a proper filling of the mold. Sometimes it may be necessary to use risers but no set rule governs. If risers are used they should be 2 inches in diameter, otherwise they will set first. In cases where the metal from one crucible has to flow or spread too far unless heated more than ordinarily, it will be advisable to pour from two or more points to avoid contraction difficulties caused by a variation of metal temperature within the mold.

Match plate molding is not a production affair. Hurry-up methods cannot be used. A perfect casting can be obtained only by a highly skilled molder with all the time he wants to spend on careful work. It does not pay to use scrap metal of doubtful composition and while match plate aluminum will cost more than ordinary kinds it is worth it in the results gained. Chills have to be used where necessary to equalize the cooling of the plate. It should be remembered that aluminum is only one-third the weight of brass. Therefore the heads must not be too low. Draws and cracks in aluminum castings can be filled in with any good aluminum solder of which there are dozens of types on the market. This filling is best done while the casting is hot. The solder should be melted on the spot to be filled, and then the surface under the solder must be scraped to remove the film of oxide, otherwise it will not adhere satisfactorily.

Q & A

Shrinkage Takes Place

I am making some matchplates 5/16 inch thick with the raised portions 1½ and 2 inches thick, 2 inches wide and 5 inches long, and am having difficulty with shrinkage. The metal is poured as cool as possible and I have tried chilling with large headed roofing nails without success. I have cored out the heavy portions to make them lighter and have good results but the objection to this scheme is that it takes too long to plug the core holes.

Your difficulty is caused by the freezing of the thin section or plate before sufficient metal can reach the heavy sections as they freeze and contact. It could be overcome by adding risers to these portions, but it probably would be unsatisfactory due to the extra work involved in cutting off the risers and finishing the patterns true to design. You may be able to overcome the shrinkage by placing heavy metal chills at the points where the heavy sections are located. This will cause the entering metal to freeze approximately at the same speed as the thin plate. You also might try placing large lumps of metal in the cavities of the heavy section. These lumps will have to be supported by nails or other means so that they do not reach the surface but are about in the centers of large cavities.

One point to be observed in using chills of any type is to see that they are perfectly dry and a little warmer than the sand enclosing them. This drying and heating maybe done with a torch just before the mold is closed. Also, the mold should be poured immediately after closing it to prevent moisture collecting on the chills. If there is much delay, blows are bound to result and spoil all your work.

Surface Defects Result

We are casting aluminum matchplates and experience considerable trouble due to surface defects which are shown in the sample forwarded to you. The metal is cast in molds made from a special sand, and the alloy is similar to No. 12, but contains 2 per cent silicon. We pour by a pyrometer which has not been calibrated recently. The temperature of the metal was slightly below 1100 degrees Fahr. The riser came up sluggishly and the overflow metal appeared distinctly mushy. A cleaner with a zinc chloride base was used on the metal which was melted in an iron pot heated by oil flame. The metal was brought to 1300 degrees before drawing. The mold was rammed firmly, but not excessively hard, and vent channels were cut in the plate parting.

The trouble in this case seems to be due to the special molding sand. Several scabs are observed on the rosette which obliterate all pattern detail. Sand from the scabs has been distributed in various places of the face of the casting. Evidently the metal has fluttered in the mold due to the gases which could not get away. Also, on the faces that are not scabbed, there is no detail. It is blurred. We suggest a change in sand. Use No. 00 Albany sand and vent the drag thoroughly with a wire. Use a perforated bottom board which is raised off the floor to allow escape of gases.

The metal also contains dirt and mush which apparently is due to the scrap from which it was made. Use new metal obtained from reputable sources, or make your own alloy from new metals. If an alloy of 8 per cent copper, 2 per cent silicon and 90 per cent aluminum is desired, hardeners containing 50 per cent copper and 50 per cent aluminum, and 50 per cent silicon and 50 per cent aluminum can be used with aluminum ingot. Use 16 pounds of the copper-aluminum alloy, 4 pounds of the silicon-aluminum alloy and 80 pounds of pure aluminum ingot.

As a flux, use only zinc chloride with aluminum and its alloys. However, in this particular case do not use any flux. Skim off the mushy metal and pour only the clean, fluid aluminum. Put the dross to one side until you have a quantity on hand and then flux it with chloride to recover the metal which can be pigged for other jobs.

Bill Discovers Many Classes of Shot

By Pat Dwyer

WITH the beginning of each school year I am reminded of the remark of the witty lad who said that the difference between the average man and the expert is that the average man knows less and less of more and more and the expert knows more and more of less and less.

Of course, I realize I am laying myself wide open to an argument there, if the eye of any expert should happen to note the foregoing statement. He—the expert, not the eye, *if* you please—immediately will point out that the reason an expert is an expert, is because he devotes himself to less and less. The field of knowledge is so wide and comprehensive and a man's life is so comparatively short, that to achieve distinction a man must concentrate on one or at most a few details. Also, and this is another interesting feature in the pursuit of knowledge, the chase is endless.

The investigator boldly grasps one root and commences to pull, under the impression that when he finds the end his search will be over. Instead of finding the end, he discovers that root branches off into a multiplicity of smaller roots, each one worthy of further investigation. Close application to one of the smaller roots discloses the amazing fact that it in turn terminates in a maze of still smaller branches. In these modern days with a horde of men diligently digging and with the hole becoming deeper every day, the man who wishes to pose as an expert and thus keep ahead of the crowd, must devote his entire attention to one of the smaller tendrils. However, I have no intention of getting involved in an argument on the subject. Let the experts fight it out among themselves. Past experience seems to indicate that is their favorite form of entertainment. As an ordinary or garden variety of the average man I am interested only in the first part of the statement that the average man knows less and less of more and more. As I said in the beginning, this fact is brought home to me with the beginning of each school year. The conviction increases in vehemence as the year progresses, but the numbing sensation commences shortly after the carefree vacation season closes. If I could get three or four stout fellas to join me, right blithely would I start a movement to abolish that insidious menace to the peace and comfort of the home, the string of problems which each little scholar drags home at night—and unloads on the bowed shoulders of the innocent parents.

Consider a typical case. After vainly wrestling for an hour with a perfectly terrible arithmetical problem, my youngest daughter—a perfectly charming little lady—sometimes—boldly proclaims that the problem is impossible of solution. Privately I am inclined to agree with her, but a meaning glance from the young lady's mother indicates that it is up to me to disprove this heretical proclamation.

With a mental malediction on the compilers of arithmetics, their ancestors and their descendants to the third and fourth generation, I patiently lay aside the quiet book and the pipe and paw through the mass of figures designed to show in bulk and in detail, what profit a second hand automobile man made during a certain period.

The first column purported to show the prices this lad paid for the various cripples in his collection. These figures were in even dollars and presented no particular difficulty in adding them up. The second column showed what it had cost him to recondition the cars to a point where they would pass the inspection of the customers.

What's That About Stinging Like an Adder?

To my intense surprise and irritation I found that this lad figured his repairs to a penny. Who ever heard of a repair man working on that principle? Every single item contained the most difficult figures from an adding standpoint. The repairs on a Ford amounted to $19.67, while others ranged from $27.63 to $97.98. Now I ask you as man to man, have you ever seen a repair bill of that kind?

Fat chance, says you, or words to that same general effect, depending on your early upbringing and the number of times the old bus has fallen down on you.

In the classic financial vocabulary of the repair man, the smallest coin with which he is familiar is two bits. He leans rather strongly to the half dollar, but his mainstay is the even dollar. So far as he is concerned, pennies, nickels and dimes do not exist. He may have heard of them in a general way, as he has heard of inches and feet, but he is not interested. He is generous and open minded. If other people care to dicker with these lesser and baser coins, why that is their privilege. He is above such petty and picayunish dealing. An even nought or a five is his irreducible figure. That's his story and he is going to stick to it. He is too busy to fritter away his time over pennies, except in lots of 25, 50, 75 or 100. Even an average man can add up columns of quarters, half dollars or dollars, but no one, except an expert adder or an adding machine can add up long columns made up of such abominable combinations at $19.67, $27.63, $97.98 and other even more fiendish combinations. The third column showed the prices he received for the various cars. In common with thousands of other average

citizens, every day I pass vacant lots where second hand cars in infinite variety are offered for sale. Never in all the years I have seen the prices displayed on these cars, have I seen one with the fraction of a dollar tacked on the main price. The price may be $10 or $500, but without a single exception, that I ever have noted, it always is marked—prominently—in even dollars.

In the face of this universally recognized fact—even the children are familiar with it—this arithmetical compiler brazenly proclaims that the dealer sold his cars for such outlandish sums as $397.33, $435.97 and others that would tax the credulity of at least two strong men. A long column of that kind of stuff would cause an adding machine to stutter and run hot in the bearings. It is one of the things that cause children to look back with pleasure on their school days. The pleasure consists in the reflection that they are past and gone. Then their children commence growing up and they experience the pleasure—bah—over again. I checked and double checked the figures up and down and in groups, but the totals would not balance. I sweated and fumed, resharpened the pencil and tried a new setup on page after page, but without result. Finally, as a last resort, I reached for the book containing the problem and slowly and painstakingly checked every single figure on the original sheet of paper with the figures as set down in the book. By this time the figures were dancing in groups and whirling in circles but by patience and perseverance I plodded through to the end.

Some day when the young lady grows up and is in a proper position to realize the enormity of the situation I am going to tell her what a narrow escape she had from a sudden and violent death on a certain night.

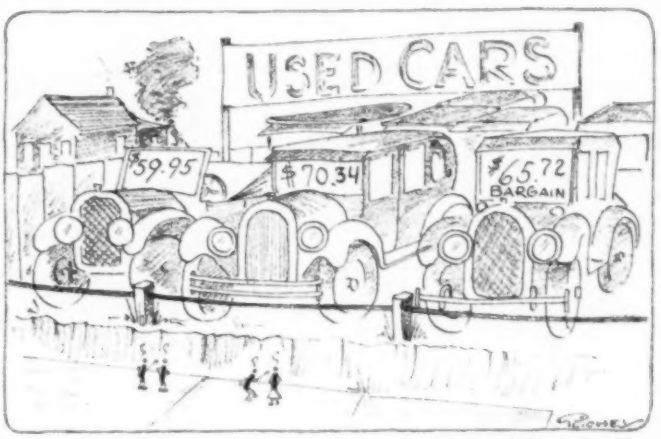
Instead of copying the figures faithfully and truly as any scholar with the peace and comfort of a poor old father at heart, should do, she had carelessly substituted a 9 for a 7 in one place, a 3 for a 6 in another and in a third and crucial position she had written 39 for 93.

Trifles, you may say, but if you had pored over them as I had, until you were dizzy, you might be inclined to revise your hasty opinion. To slightly paraphrase old what's—his—name's classic remark: Trifles make a holy mess and believe you me one of these tangles is no trifle.

The best part of a quiet and domestic evening was shot to tatters. Then to finish it off properly, the lady who had watched me writhing and wrestling in agony for an hour, delicately rubbed a few pinches of salt in the edges and around the gaping wounds.

"You should have looked in the book in the first place," she observed calmly "and checked the accuracy of the figures before attempting to do anything with them. You cannot expect a child to have a camera eye or the proficiency of an adding machine. Considering the time and mental effort you expended, one would think you were auditing the books of the United States Steel corporation, instead of doing a simple sum in addition. What are you going to do when she goes into high school and brings home some real problems?"

"My dear," I responded gallantly, "when that time arrives, when she brings home any of that stuff—I know a better word, but stuff will suffice in the present instance—I shall gently and noiselessly fade out of the picture and shall allow you to take the wheel. Nothing could be fairer than that even in the merry month of May."



Some Have Fenders and Some Have None, But What Do You Expect for 9.91?

"No," she admitted enigmatically, "nothing could be fairer—or more characteristic!" Now, I wonder what she meant by that.

If I had been sufficiently inquisitive I might have pushed the inquiry farther and waded in a little deeper, but domestic experience gained over a long period of years, prompted me to emulate Bre'r Rabbit and lie quiet in the bramble bush. Wading presents many interesting features, but stepping off a shelf into water over one's head is not one of them.

When Bill came in the other night I asked him how he dealt with this home work problem over at his house. He is an ingenious and resourceful lad and I felt reasonably sure he had discovered a solution. My faith was not displaced.

"Simplest thing in the world," he assured me airily, "when the youngsters commence flourishing the books and papers, I grab my hat and beat it. I let 'em fight it out among themselves. They need the exercise and I don't."

"I don't mind answering sensible questions, showing a boy or girl, or an older person, how to reason out a problem, but I don't believe any good is accomplished by adding up silly rows of figures for them. That is only practice for them and believe me they need lots of practice."

"Sit you down my boy," I said, "while I test your willingness to answer a few miscellaneous questions, nothing difficult, you understand—"

"Say! What's the big idea?" Bill inquired, suspiciously, "are you trying to put something over on me? I suppose you have been reading some of these believe it or not things. You know the answer to some tricky or involved proposition and you just want to show off your superior knowledge."

"Bill," I said, "you are doing me a grave injustice, harboring such entirely uncalled for suspicions. Between ourselves I don't mind admitting that I am tired of trying to work impossible problems. I want to sit on the opposite side of the fence for a change and enjoy the pleasure of watching another person squirm."

"What a nice, sweet tempered little lad you are," Bill remarked, "I bet when you were young, your chief pleasure was derived from such innocent sport as hanging cats by the tails over clothes lines and robbing bird's nests. I knew a fellow like you one time, and do you know what happened to him?" "No," I said, "I do not know what happened to him. He probably developed into a solemn old gent with side whiskers and a white waistcoat, with a pet theory that all little boys should be confined in cages and fed on canary bird seed, animal crackers and other innocuous food designed to keep their devilish propensities in proper check.

"However, all that has nothing to do with the present subject. I am just going to ask you a simple question."

"All right," said Bill. "All right. Shoot."

"Shoot is the word," I said. "What do you know about shot?"

"Shot? What kind of shot have you in mind? *BB*, buck or bird? Perhaps you are thinking of shot silk, shot towers, pay the shot, half shot, a shot of chain, the last shot in the locker, a shot of hooch or dope, cannon shot, hot shot, chain shot, cold shot or putting the shot. Kindly be a little more specific, dear lad."

"There you are," I pointed out triumphantly, "That is the kind of proposition I am up against constantly. What I had in mind specifically in this instance is an inquiry I had recently from a man in England. He wanted to know if I could tell him anything about the manufacture of chilled shot in America. How is it made and what price is obtained for the finished product. What is the difference between chilled shot and the hard cast iron balls sometimes men-

tioned. What is the particular destination of each of these products—if they are different products."

"Well," said Bill, "I'll tell you. You would think after all the publicity in the editorial and advertising sections of the technical press, and the wide spread use of the process in which the material is used, that everyone, at least every one connected with the foundry industry, would know all about chilled shot, what it is, how it is made, the price at which it may be purchased and the purpose for which it is intended.

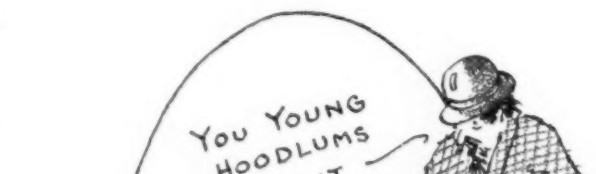
"At first, the idea of confusing chilled shot with cast iron balls, struck me as the height of something or other, but on second thought I realize how easily a man, who perhaps never had seen either, might fall into error. In the mind of the average man, the term shot means a projectile of some kind to be fired, either singly or in bulk, from a gun. It is supplied in all sizes from that of a small pin head up to buck shot and *BBB*, 0.25 inches in diameter. This is the standard lead shot, 98 per cent lead and 2 per cent antimony. However, that is not the only kind of shot that pops into a man's mind when the word is mentioned. The old muzzle loading cannon have been out of active service for many years, but many of the terms used in connection with these old implements of warfare, still remain and are used freely. Indeed it is my private opinion that a great many people are under the impression that round cannon balls or cannon shot still are stuffed into the front end of the cannon and then shot forth with great speed and violence against the perfidious enemy. In nearly every war memorial, a pyramidal stack of round cannon balls or cannon shot, takes a prominent place and helps to keep the old war spirit alive. I often have wondered why war memorials take such vindictive forms. Instead of erecting something symbolic of sorrow for those who are gone and a desire for peace on the part of those who survive, the committee, or whoever has charge of the job, sets up something to show that we are all ready and just spoiling for another fight."

"*A bas* the war," I said, "In other words lay off. Stick to the chilled shot."

"Anything for peace," said Bill, "Le's see where was I? Oh, yes. Chilled shot is an exceedingly hard cast iron product employed in the same manner as sand in operations where the sandblasting method is employed for cleaning or cutting.

"Chilled shot is a man made product to a certain extent, but it obtains its shape through natural forces instead of in a mold. Hard iron is melted in a cupola and allowed to trickle in a small stream from the spout. As it falls, it is disintegrated by a stream of water, air or steam and falls into a tank filled with water. Part of the iron falls in the shape of small globular drops. This is known as shot. The remainder simply falls as disintegrated material and is known as grit.

"The shot is separated from the remainder and graded according to size. The miscellaneous material is crushed and then separated according to size. It is known as angular grit and usually simply as grit. Some users prefer one and some prefer the other. Of course under certain conditions the shot is the more suitable, while under other conditions the reverse may be true. Foundrymen have their choice.



He Loves to Mingle with the Boys —and Jam the Works

"Sandblasting — irrespective of whether sand or metal abrasive is employed—is not confined to the foundry, or to the sole purpose of cleaning castings. The process finds wide application in many other fields from cleaning old paint from freight cars, to carving designs in wood and stone.

"The hard cast iron ball is a different product altogether. It is a man made product, rarely less than ¾-inch in diameter, formed in a sand or iron mold and poured from an iron mixture approximating that of malleable iron before it is annealed. In other words it is a white iron in which practically all the carbon is in the combined form. An iron which will show a brinnel hardness of about 500.

"These balls are employed for grinding purposes in many industries. They are placed with the material to be ground in revolving barrels. For example copper ore, cement clinker, enamel frit, etc., are reduced to powder in this manner. The balls vary in size from 1 to 6 inches diameter and perhaps have their greatest field of usefulness in the mining industry, or, more properly speaking, in the treatment of the ore after it has been taken from the mine.

"You probably are familiar with the term *ball mill*. It is called a ball mill because the material to be treated is reduced to a powder through the abrasive and crushing action of a large quantity of hard cast iron balls.

New England Founders Discuss Costs

The need for uniform cost accounting among foundries was emphasized at the regular monthly meeting of the New England Foundrymen's association held Oct. 8 at the Engineers club, Boston. This meeting was a symposium on the subject "What's Wrong with the Foundry Business and Why?" The subject was discussed by the following five representatives of principal New England foundry districts: H. P. Blumenauer, Arcade Malleable Iron Co., Worcester, Mass.; Norman Russell, Albert Russell & Sons Co.; Newburyport, Mass; Bert Evans, George H. Lincoln Co., South Boston; Le Roy M. Sherwin, Browne & Sharp Mfg. Co., Providence, R. I.; and Carl S. Neumann, Union Mfg. Co., New Britain, Conn. All speakers agreed that one of the most important problems in the foundry industry was costs. Mr. Blumenauer told of a cost group now being formed in the Worcester district and later in the meeting the association went on record as favoring the enlarging of that group to include the entire New England district. Many of the foundrymen present signified their intention of joining such a group.

Another need in the industry which was discussed by several speakers was the expansion of the castings field by an increase in the strength of material. Foundrymen were urged to keep abreast of new developments in alloys and thus be able to raise the standards and usefulness of the castings industry by furnishing products of high strength. One speaker cited a case of high temperature, high pressure work, where castings showed a greater strength than a product produced by the means of fabrications.

The need for modern equipment in foundries also was stressed. Mr. Sherwin told of revamping the Brown & Sharpe foundry, stating that by the use of continuous annealing furnaces, quality of product had been improved and cost of pro-

duction reduced to such an extent that many new outlets were developed.

The meeting aroused a great deal of interest and more discussion along the same lines was planned for the future. Ernest F. Stockwell, president of the association, announced that the next meeting will be held in Providence, R. I. Questions raised at the Boston meeting will be answered at that time.

Readers Comment

Note—Material appearing under this head does not necessarily reflect the opinion of The Foundry or of its editors.

To The Editors:

I noticed a question on page 64 of the Sept. 15 issue entitled, "Jacket Core Causes Blow," in which the questioner was under the impression that his core mixture for laundry-heater fire-pot cores was at fault. That may be the cause of the loss and on the other hand it may not have any bearing on the question.

From an experience of over 30 years in boiler and radiator plants, I venture to say that cores of that class blow more frequently because the chaplets are not sufficiently heavy to stand up under the flow of molten metal. That class of castings has two outlets. The vent from the main core is carried off through the upper outlet in most cases. The small round core that carries this vent is set in place after the cheek has been closed. In most shops, that core is set against the barrel core with flour paste or moist plumbago after the cheek is in place. Once the core has been set, care must be taken that it is not moved.

The barrel core is surrounded almost entirely by metal. Chaplets must be sufficiently heavy so that the metal will not melt or soften them. If a stem type chaplet is used, it should be made of not less than ¼-inch wire. That applies to both top and bottom chaplets. Supports for the chaplets in the drag should be such that they will not give way while the core is keyed in place. Use a stud chaplet substantial enough to stand up under the flow of metal.

Any chance that the barrel core has to move out of place during pouring or immediately afterward will cause a blow, for any such movement will cause the barrel core to move away from the core that carries the vent. Iron may get into the opening thus formed and choke the vent. If there is any give to the chaplets in the drag or the supports on which they rest, the main core may be moved out of alignment and partly close the outlet.

Another thing to keep in mind is that there is quite a volume of gas generated in a core of this type and there must be head enough of iron in the cope to overcome this gas pressure. If the cope is shallow a head box should be used to allow sufficient head to be fed to the casting.

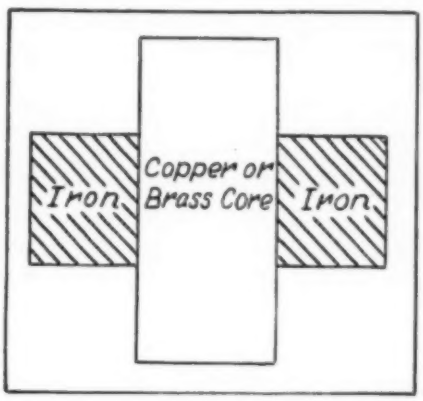
D. E. Foley

118 *Asylum Street,*
Norwich, Conn.

Copper Core Expands

To the Editors:

In the Oct. 1 issue under the title "To Make Cam Chills," an inquirer asked if pieces of steel shafting could



After the Casting Is Cool, the Core May Be Removed

be used to form the cores for the chills.

Some time ago the writer had a similar problem to solve, and found that if a piece of brass or copper is substituted for the steel shafting, and given a protective coating (provided the chill is not too big), the desired result is accomplished. The reason, the writer believes, is that the brass or copper shaft expands when the cast iron is in a *mushy* state. The iron due to its condition yields easily to the expanding brass or copper shaft. Freezing then takes place, and when cool the brass or copper shaft may be removed because it has contracted to its normal diameter while the hole formed in the cast iron remains approximately the diameter of the expanded nonferrous shaft.

J. L. Dostal,
Manager
Holley Permanent Mold-Machine Inc., Detroit

Metal Is Overheated

To The Editors:

In the Sept. 15 issue, page 69, there is a question entitled, "Sand Is Prepared," which deals with a suitable sand for making bronze tablets. The answer suggests a facing sand that I have used many times successfully. Since some of the finest bronze castings are made in French sand, I can see no reason to suggest a change in this respect other than to reduce the cost of the sand. French sand or the facing sand suggested, when properly used, will not cause gas inclusions in the tablets but overheated metal will result in inclusions.

When the tin content is high, the searching characteristics of the metal are increased, causing it to burn into the fine lines of the mold when it is too hot. That leaves the casting blurred and pitted on the surface. If the metal suggested is used and is poured at a temperature of 2100 degrees Fahr., no trouble will be encountered in making bronze tablets in French sand.

Many molders are afraid of that class of work because of misruns. Instead of increasing the number of sprues leading to the runner, they overheat the metal and that is the cause of much trouble. While the question that was asked was answered, I feel that the inquirer should not be left with the idea that his sand is at fault because if he should use the sand suggested and continue to overheat the metal, he will have the same unsatisfactory results.

Gas inclusions indicate overheated metal. With the metal in that condition, any of the troubles mentioned may happen. Small castings for fine brass work are made successfully in many foundries with Windsor lock and fine Albany sands. If good castings cannot be made from those sands, then there is something in the foundry methods being used that should be changed.

H. W. Bennett

148 *Harvard Avenue,*
Montreal, Que., Can.

Will Manufacture Cupola Charging Machine

Dobbie Foundry & Machine Co., 150 Portage road, Niagara Falls, N. Y., has purchased manufacturing rights on the cupola charger and charging equipment formerly made by the Chisholm-Moore Hoist Corp., Tonawanda, N. Y. W. H. Morgan will be in charge of the equipment division of the company. The Dobbie Foundry & Machine Co. has made contractors' equipment, castings and structural steel products for a number of years and is equipped to build machinery of the type of the cupola charger.

The Shakeout

DAN M. AVEY, *Editor*
FRANK G. STEINEBACH, *Managing Editor*
PAT DWYER, *Engineering Editor*
EDWIN BREMER, *Metallurgical Editor*
CHARLES VICKERS, *Nonferrous Editor*
NORMAN F. HINDLE, *Assistant Editor*

¶ Thumbnail Business Foresight

AN ARTIST measures the size of a distant mountain by sighting along his thumbnail. Of course, he is not so minimizing the size, scope or importance of the towering landscape, but his job is to reduce the horizon to the boundaries of his painting. In these days of dull business and intensified competition, many castings manufacturers measure the value of their costs by the thumbnail of the expense required to determine such costs. They minimize the importance of accurate costs and count only the outlay in clerical expense.

AN INSTANCE is cited of one company, long a firm believer in the best possible cost analysis upon which to base every estimate. This company debated whether it would not be best to abolish the cost department, save clerk hire and office expense since it had become necessary to cut every price to prevent competitors from taking away the business even of customers of long standing. However, they decided against such a backward step. It was observed that it would not be safe to cut prices without knowing costs and that the level of price below which they could not afford to go in meeting ignorant competition would be established only through knowing costs. One saving factor is the fact that the price cutting competitor, who did not know his costs probably soon will cease to trouble and the cost-minded foundry will find success.

¶ Advance in All Sectors

MILITARY authorities, football coaches, and many who lead and direct, have used the saying that the best defense is a good offense. In times past, it appeared that the foundry industry was on the defensive. It still is, but its defense is its good offense. As an instance, the Anaconda Copper Mining Co. was having considerable trouble with the method of coupling its mine cars. The coupling mechanism broke quite frequently and many cars had to be run to the surface for repairs. A welded method of construction was used which was easily replaced when the car was once brought to the surface. However, repairs to mine cars resulted in considerable expense, not only because of frequency but through lost time. A steel foundry now is casting coupling devices for the mine cars and that method of construction has reduced materially the repair costs for the company, not only because of the less frequent breaks but also because less time is lost due to breakage and repairs.

¶ Accidents Low in Foundries

THE foundry worker has a much greater chance of escaping death from accident than workers in many other industrial fields, but death rates from all causes except accidents are high in the foundry industry. This interesting information is revealed in a bulletin dealing with occupation mortality, which recently has been published by the U. S. treasury department, public health service. The data were secured through a joint investigation of the Actuarial Society of America and the Association of Life Insurance Medical Directors, and statistics cover 1,300,000 entrants and 22,000 deaths during the years 1915-1926.

In the survey of death rates due to occupational accidents, *molders, founders and castors of iron and steel* are placed far down the line with a yearly total of 0.17 deaths in each 1000 as compared with a rate of 5.19 per 1000 for linemen and cable splicers in electric light and power plants, the most hazardous occupation listed. For years, pioneers in accident prevention have been working in the foundry industry, and the splendid showing carried in this report indicates the progress made.

HOWEVER, in considering the death rates in industry from all causes except accidents, the foundry does not appear in the same light. Molders, founders and castors of iron and steel, rank second in a long list of workmen, having a death rate of 4.59 per 1000, compared with 5.46 per 1000 for the highest group. The report indicates that tuberculosis of the lungs is one of the important causes of death in that group and that dust is an important factor in tuberculosis.

Great improvements in dust collecting and removal equipment as well as in heating and ventilating foundries have been made since the period in which the data for the report were collected. Undoubtedly, a survey of the industry today would indicate a decrease in the rate. However, the management should see that every effort is made to protect employes from disease which may be contracted while at work. Not only will such measures pay from the humanitarian standpoint, but through a lower labor turnover, higher efficiency and more satisfied workmen, it will pay in actual dividends.

Comings and Goings of Foundrymen

Men of the Industry, Whose Activities Are Making Foundry History

HERBERT E. FIELD, formerly president and general manager, Wheeling Mold & Foundry Co., Wheeling, W. Va., and later vice president, and treasurer Continental Roll & Steel Foundry Co., Chicago, has resigned the latter position to become manager of roll sales for the Mesta Machine Co., Pittsburgh. Mr. Field began his career in the foundry industry with the Builders' Iron Foundry, Providence, R. I. He left that company to become associated with the Farrell Foundry & Machine Co., Ansonia, Conn., and later became connected with Mackintosh-Hemphill Co., Pittsburgh. He left that company after 10 years to accept the position of president and general manager, Wheeling Mold & Foundry Co., Wheeling, W. Va. He occupied that position until the recent merger of the company with the Continental Roll & Steel Foundry Co., Chicago.

Charles H. Hoefer has resigned as plant superintendent with the Duraloy Co., New Cumberland, W. Va.

B. F. Mercer, general superintendent, Union Steel Casting Co., Pittsburgh, subsidiary of Blaw-Knox Co., has been elected vice president of the Union company.

W. T. Howell, foundry superintendent, Kay-Brunner Steel Products Inc., Los Angeles, has been appointed plant manager. H. M. Stoneham, sales engineer for several years, is now production manager.

A. S. Kirkpatrick, foundry superintendent, Southern Desk Co., Hickory, N. C., has resigned to take over the supervision of the foundry department of the High Point Machine & Mfg. Co., High Point, N. C.

W. L. Krug, formerly superintendent, McCormick works, malleable iron foundry, International Harvester Co., Chicago, has been appointed to a similar position with the Wm. E. Pratt Mfg. Co., Joliet, Ill. He succeeds the late James Beaman who held that position for 32 years.

William Stringham, formerly assistant general superintendent, American Rolling Mill Co., Middletown, O., has been appointed assistant vice president in charge of rolling and foundry work at the company's East works. He has been associated with the company for almost 30 years.

E. A. Balsley, has become affiliated with the Ohio Steel Foundry Co., Lima, O. He formerly was associated with the Wheeling Mold & Foundry Co., Wheeling, W. Va., as vice president in charge of operations and later was connected with the Continental Roll & Steel Foundry Co., Chicago.

Eugene Tetzlaff, first vice president and director, General Bronze Corp., Long Island City, N. Y., has been placed in charge of the western division of the company with headquarters in Minneapolis. Through an error Mr. Tetzlaff's headquarters were given as Chicago in the Oct. 1 issue.

Martin Gilligan, formerly pattern shop clerk, American Steel Foundries

Herbert E. Fields

East St. Louis, Ill., has been appointed general clerk. Frank Leveling, formerly machine shop clerk, has been advanced to the position formerly occupied by Mr. Gilligan. Dave Coombs has been transferred from the main office of the plant to fill the vacancy as machine shop clerk.

Stanley M. Tracy, treasurer, Driver-Harris Co., Harrison, N. J., recently was tendered a dinner by his associates in celebration of his twenty years service with the company. Mr. Tracy started as office manager of the American Wire Cloth Co., a subsidiary company and was elected treasurer and director in 1922. In 1929 he was made a director of the British Driver-Harris Co.

E. W. Kopke, formerly vice president and manager, Fulton Iron Works, St. Louis, has been advanced to the presidency, succeeding H. J. Steinbreder, who was made chairman of the board. The board also elected Joseph W. Lewis vice president, and re-elected G. J. Kienzle secretary and treasurer. R. E. Adams was named assistant secretary and assistant treasurer, a new office.

Opens District Offices

Palmer-Bee Co., Detroit, recently has opened the following district offices: Room 333, Ellicott Square building, Buffalo; Room 508, Farmers Bank building, Fifth avenue and Wood street, Pittsburgh; Room 1056, Rockefeller building, Cleveland; Room 1210, Reynolds building, Winston-Salem, N. C.; and Bulletin building, Philadelphia. The following men have been appointed district managers: C. E. Jeremias, Buffalo; C. E. Musselman, Pittsburgh; F. B. Barkwill, Cleveland; E. S. Davidson, Winston-Salem, N. C.; and S. T. Transeau, Philadelphia.

Budgets Aid Control

Use of budgets as an aid to management in controlling overhead production and purchases was urged by E. S. LaRose, assistant comptroller, Bausch & Lomb., Rochester, N. Y., in addressing the New York chapter of the National Association of Cost Accountants at the Builders club, 2 Park avenue, New York, Oct. 14. Mr. LaRose pointed out that present rapidly changing business conditions make scientific forecast more important than ever, not only to the individual concern but to the prosperity of the nation.

Minor wastes as well as gross extravagance in planning activity threaten even the best managed concerns in these days of intense competition the speaker said. Executives can correlate inventories and production to selling with great precision by means of budgetary control that takes all factors into consideration.

Mr. LaRose said that many large and small industries believe they are working on a budget when more often their sales budget is entirely distinct and divorced from the operations in the plant and therefore unbalanced. Large losses which now are being sustained by many organizations due to the suddenness with which the business depression descended could have been minimized by budgetary control.

Cleveland offices of the Milwaukee Electric Crane & Hoist Corp., and the Harnischfeger Corp., both of Milwaukee, have been consolidated. Combined offices of the companies will be located at 342 Rockefeller building with D. B. Patterson as manager.

Officers Are Elected

E. L. Mills, sales manager, Bastian-Blessing Co., 240 East Ontario street, Chicago, recently was elected president of the Gas Products association, 608 South Dearborn street, Chicago. It is the first time since the organization of the association 12 years ago that a representative of a manufacturer of oxyacetylene welding and cutting equipment has been elected president.

Other officers of the association include: A. J. Fausek, Modern Engineering Co., 3411 Pine street, St. Louis and W. H. Ballance, Electrox Co., Peoria, Ill., vice presidents; H. B. Pearson, Compressed Industrial Gases Inc.; M. L. Goodrich, Swift & Co., Chicago; W. D. Flannery, K-G Welding & Cutting Co. Inc., 515 West Twenty-ninth street, New York; O. E. Engler, Balbach Co.; L. F. Loutrel, Shawinigan Products Corp., 110 Williams street, New York; E. H. Smith, Commercial Gas Co., 2633 Fourth street, southwest, Minneapolis; Parker B. Francis, Kansas City Oxygen Gas Co.; and E. J. Flood, Page Steel & Wire Co., Bridgeport, Conn., directors. C. T. Price is commissioner of the association.

Cast Pipe Data Given

Results obtained from the investigation of 6 and 8-inch cast iron water pipe are presented in a 40-page bulletin entitled "A Comparison of the Physical Properties of Various Kinds of Cast Iron Pipe," by F. N. Menefee and A. E. White, which recently was published by the department of engineering research, University of Michigan, Ann Arbor, Mich. Pipe made by 4 different processes by 6 different firms were tested for tensile resistance; radial compression, resistance, and deflection; transverse bending resistance and deflection; impact resistance; variation in thickness; chemical composition, and metallographic constitution. The price of the bulletin is 50 cents.

U. S. Pipe Acquires the Davies & Thomas Co.

Davies & Thomas Co., Catasauqua, Pa., recently has become associated with the United States Pipe & Foundry Co., Burlington, N. J. Davies & Thomas Co. will continue to operate under its own name. New officers of the company are: George Davies, 342 Madison avenue, New York, president and treasurer; D. P. Hopkins, Burlington, N. J., vice president; Charles R. Rauth, Burlington, N. J., secretary; F. J. Walker, Catasauqua, Pa., assistant secretary and assistant treasurer. The board of directors includes Messrs. Davies, Hopkins and Rauth, D. B. Stokes, Burlington, N. J.; H. A. Hoffer, Philadelphia, and H. V. Overholt, Pittsburgh.

Industrial Truck association, New York, has moved its offices to 60 East Forty-second street from 52 Vanderbuilt avenue.

Foundry Association Directory

American Foundrymen's Association

President, N. K. B. Patch, Lumen Bearing Co., Buffalo; executive secretary-treasurer, C. E. Hoyt, 222 West Adams street, Chicago; technical secretary, R. E. Kennedy, 222 West Adams street, Chicago. Annual meeting, Stevens hotel, Chicago, May 4-7, 1931.

Associated Brass Founders of New England

President, George W. Thornburg, Crescent Park Brass Foundry, Waltham, Mass.; secretary, R. B. Bonner, Somerville Machine & Foundry Co., 14 Kent street, Somerville, Mass. Meeting the fourth Wednesday of each month at the Engineers' club, Boston.

The Buffalo Foundrymen

President, J. McArthur, Washington Iron Works; secretary, W. J. Wark, E. J. Woodison Co., 140 Chandler street. Meetings each month at club rooms, 140 Chandler street.

Central Illinois Foundrymen's Club

President, H. M. Hire, Hire Foundry Co., Peoria, Ill.; secretary, Franklin Whitehead, The Meadows Mfg. Co., Bloomington, Ill.

Chicago Foundrymen's Club

President, H. P. Evans, Continental Roll & Steel Foundry Co., East Chicago, Ind.; secretary, Albert N. Wallin, S. Obermayer Co., 2563 West Eighteenth street. Meetings first Thursday in each month at the City club, 315 Plymouth court.

Connecticut Foundrymen's Association

President, Carl S. Neumann, Union Mfg. Co., New Britain, Conn.; secretary, Charles S. Parker, Charles Parker Co., Meriden, Conn. Meetings are on second Friday of each month in various parts of the state.

Detroit Foundrymen's Association

President, James L. Mahon, American Car & Foundry Co.; secretary, William J. Muhlitner, Great Lakes Foundry Sand Co., 2100 Penobscot building, Detroit. Meetings third Thursday in each month, except December, June, July and August at Ft. Shelby Hotel.

East Bay Foundrymen's Association

Secretary, O. R. Moller, Electric Steel Foundry Co. Inc., 1328 Second street, Berkeley, Calif.

Electric Steel Founders' Research Group

Director, R. A. Bull, Assistant Director, C. N. Ring; Central Office, 541 Diversey Parkway, Chicago.

Gray Iron Institute

President, B. H. Johnson, Florence Pipe Foundry & Machine Co., Florence, N. J.; manager, Arthur J. Tuscany, Terminal Tower building, Cleveland.

Malleable Iron Research Institute

President, R. R. Fauntleroy, Moline Malleable Iron Co., St. Charles, Ill.; secretary, Robert E. Belt, Union Trust building, Cleveland.

Metropolitan Brass Founders' Association

President, William Ember, Jefferson Brass Foundry, 62 Delevan street, Brooklyn, N. Y.; secretary, William E. Paulson, Thomas Paulson & Son Inc., 97 Second avenue, Brooklyn, N. Y. Meeting second Wednesday in each month at the Building Trades club, 2 Park avenue.

Newark Foundrymen's Association

President, W. H. Mantz Atlas Foundry Co., Irvington, N. J.; secretary, G. W. Hannay, Barnett Foundry & Machine Co., Irvington, N. J. Meeting called by president. Scheduled meeting dates: Oct. 22; Dec. 3; Jan. 28; March 25; May 27.

New England Foundrymen's Association

President, Ernest F. Stockwell, Barbour-Stockwell Co., Cambridge, Mass.; secretary Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass. Meetings held the second Wednesday of each month. Outings usually are held in the summer months.

Ohio Foundries Association Inc.

President, Don McDaniel, Hamilton Foundry & Machine Co., Hamilton, O.; secretary, Robert Hoierman, 418 Penton building, Cleveland. Annual meeting Nov. 13 at Columbus, O.

Pacific Coast Founders Association

President, Charles J. P. Hoehn, Enterprise Foundry Co., 2902 Nineteenth street, San Francisco; manager, S. M. Truitt, 55 New Montgomery street, San Francisco.

Philadelphia Foundrymen's Association

President, C. F. Hopkins, Ajax Metal Co., Philadelphia; secretary, Earl Sparks, 1623 Sansom street, Philadelphia. Meetings the second Wednesday of each month at the Manufacturers' club.

Pittsburgh Foundrymen's Association

President, W. E. Troutman, Duquesne Steel Foundry Co., Pittsburgh; secretary-treasurer, William J. Brant, Wm. J. Brant, Bessemer building, Pittsburgh. Meeting on the third Monday of the month, except in July and August at Fort Pitt hotel.

Quad City Foundrymen's Association

President, R. L. Eichman, Bettendorf Co., Bettendorf, Ia.; secretary-treasurer, Stanley Brah. Meetings the third Monday of each month, the meeting place being rotated between Moline, Rock Island and Davenport.

St. Louis District Foundrymen's Club

President, Horace R. Culling, Carondelet Foundry Co., St. Louis; secretary-treasurer, Leo J. Filstead, John C. Kupferle Foundry Co., St. Louis. Meetings the fourth Thursday of the month at 6:30 p. m., at the American Annex hotel, Sixth and Market streets, St. Louis.

Southern Metal Trades Association

President, John S. Schofield, J. S. Schofield's Sons Co., Macon, Ga.; secretary, W. E. Dunn Jr., Flatiron building, Atlanta, Ga.

Steel Castings Development Bureau

Research Director, George Batty, 500 Stock Exchange building, Philadelphia.

Steel Founders' Society of America

President, J. E. McCauley, Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.; managing director, G. P. Rogers, Graybar building, New York.

Tri-City Technical Council

Chairman, C. F. Scherer, Davenport Machine & Foundry Co., Davenport, Iowa; secretary, E. C. Xander, assistant secretary, Tri-City Manufacturers association, Moline, Ill. Combined meetings held only one or two times a year on call.

Tri-State Foundrymen's Association

President, William Hoppenjanz, The Star Foundry Co., 221 Main avenue, Covington, Ky.; secretary, C. C. Erhart, Chris Erhart Foundry Co., Cincinnati. Meetings the second Thursday of each month at the Cincinnati club, Eighth and Race streets.

Twin City Foundrymen's Association

President, William J. Snyker, St. Paul Foundry Co., St. Paul; secretary-treasurer, C. E. Langdon, 3849 Lyndale avenue, south, Minneapolis. Meeting third Wednesday of each month at Athletic club.

Washington Foundrymen's Club

President, J. W. Orphan, Lake Union Foundry Co., 1703 Westlake avenue, Seattle; secretary, Edward C. Gustin, The Prescott Co., 1 West Lander street, Seattle. Meetings second and fourth Tuesdays of each month at the Elks Temple, Fourth avenue and Spring street.

Western Foundrymen's Association

President, H. T. Hornsby, Joplin, Mo.; secretary, E. L. Graham, Acme Foundry & Machine Co., Coffeyville, Kans.

Wisconsin Gray Iron Foundry Group

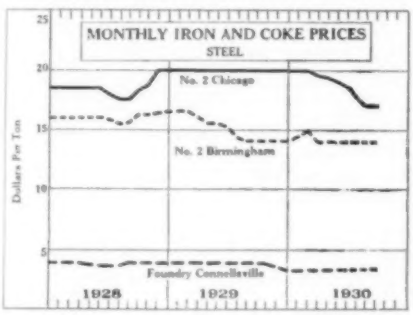
Secretary, W. F. Bornfleth, Cutler-Hammer Inc., Foundry Division, Milwaukee. Meetings on first Wednesday of each month at Hotel Schroeder, Milwaukee.

Trade Trends in Tabloid

PRACTICALLY no change has been noted in foundry operations during the past month. However, business sentiment generally has improved to a degree, with several factors adding a more cheerful tone to the situation. Complete statistics for September indicate that business during that month was slightly better than preliminary reports indicated.

—T—T—

Production of malleable castings gained from 25,614 tons in August to 26,510 tons in September, according to a report of the department of commerce. Total production for the first nine months of the year was



128,655 tons against 666,842 tons during the same period in 1929. September bookings totaled 25,753 tons.

—T—T—

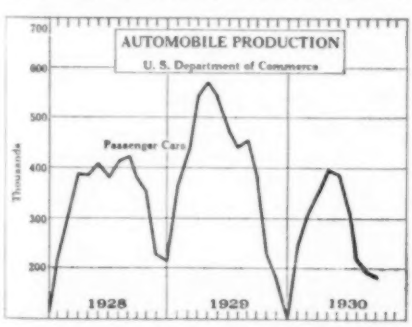
Index of gross orders for foundry equipment in September was 91, compared to an index of 85.2 in August, according to the Foundry Equipment Manufacturers association. The index of unfilled orders on Oct. 1 was 170.8 against 140.2 on Sept. 1.

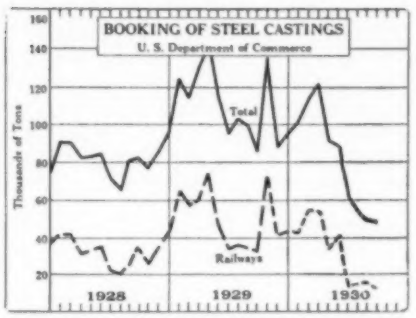
—T—T—

Foundry operations remain at about 55 per cent for the Chicago district, little change being noted since the first of October. While one or two implement foundries are running close to capacity, the industry's operations are spotty. Brass foundries working on oil field or refinery goods have fair business. Steel Foundries have dropped off slightly.

—T—T—

Deliveries of brass and bronze ingot and billets by members of the





Non-Ferrous Ingot Metal institute during September totaled 5704 tons. Unfilled orders on Oct. 1 amounted to 18,386 tons.

—T—T—

Through Central New York, furnace, stove and heater foundries are busy. Jobbing shops are quiet and a number have shut down temporarily. However, conditions are on the upgrade, according to observations of foundrymen in that section.

—T—T—

Six hundred and seventeen railway locomotives were purchased during the first 9 months of 1930, compared with 592 during the same period in 1929. Sixty-five locomotives were shipped in September.

—T—T—

With the Baltimore & Ohio railroad deciding to build 2000 cars in its own shops, October became the heaviest freight car buying month since March. It is reported that the Illinois Central will issue new specifications for 2300 cars after Jan. 1.

—T—T—

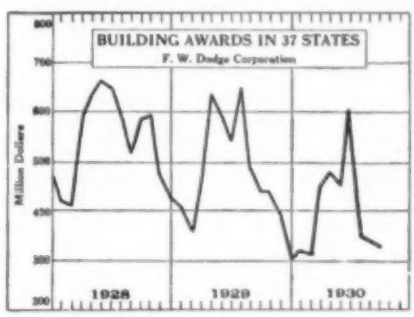
Construction awards for the 37 states east of the Rocky Mountains during September were valued at $331,863,500, a decline of almost 5 per cent over the August total.

—T—T—

Automobile production in September held up better than was expected. Output of passenger cars totaled 186,579 during the month.

—T—T—

Orders for steel castings declined in September, according to a report of the department of commerce. Bookings for that month totaled 49,618 tons, or 34 per cent of capacity,



compared with 51,464 tons or 36 per cent in August.

—T—T—

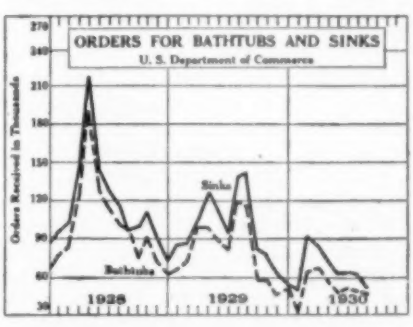
Farm implement manufacture is expected to recover its equilibrium with a fair degree of speed, according to views expressed at the recent meeting of the National Association of Farm Equipment Manufacturers.

—T—T—

Gray iron foundries in the Northern New Jersey and New York district are operating at a capacity of 50 to 55 per cent, in a few remote instances slightly heavier. Malleable shops are on about the same schedule. Brass and bronze foundries generally are on curtailed output. Steel foundries in the East have, in some cases, a few fair railroad orders. Machine tool castings, however, are in light demand. Cast iron pipe operations are averaging close to 60 per cent. Large pipe sizes are ahead of last year. Slow municipal buying for the last two months has reduced backlogs.

RAW MATERIAL PRICES
October 22, 1930

Iron	
No. 2 foundry, Valley	$17.00
No. 2 Southern, Birmingham	14.00
No. 2 foundry, Chicago	17.50
No. 2 foundry, Buffalo	17.50
Basic, Valley	17.00
Basic, Buffalo	17.00
Malleable, Chicago	17.50
Malleable, Buffalo	18.00
Coke	
Connellsville beehive coke	$3.50 to 4.85
Wise county beehive coke	4.25 to 5.00
Detroit by-product coke	8.50
Scrap	
Heavy melting steel, Valley	$14.50 to 15.00
Heavy melting steel, Pitts.	14.25 to 14.75
Heavy melting steel, Chicago	11.00 to 11.50
Stove plate Buffalo	9.75 to 10.25
Stove plate, Chicago	8.00 to 8.50
No. 1 cast, New York	9.50 to 9.75
No. 1 cast, Chicago	11.00 to 11.50
No. 1 cast, Philadelphia	13.50
No. 1 cast, Pittsburgh	13.50 to 14.00
No. 1 cast, Birmingham	11.50 to 12.00
Car wheels, iron, Pittsburgh	14.00 to 14.50
Car wheels, iron, Chicago	12.50 to 13.00
Railroad malleable, Chicago	13.00 to 13.50
Agricultural mal., Chicago	11.50 to 12.00
Malleable, Buffalo	14.50 to 15.00
Nonferrous Metals	**Cents per pound**
Casting, copper, refinery	9.62½
Electro, copper, producers	10.00 to 10.12½
Straits, tin	27.00
Aluminum, No. 12, producers	22.00
Aluminum, No. 12 remelt	13.50
Lead, New York	5.10
Antimony, New York	7.37½
Nickel, electro	35.00
Zinc, East St. Louis, Ill.	3.95 to 4.00



OBITUARY

John Patton, treasurer, North Wales Foundry Co. Inc., North Wales, Pa., died Sept. 20.

Wilson K. Levering, president, National Sash Weight Co., Baltimore, died Oct. 5, as a result of a fall from his horse.

Thomas C. Wolverton, secretary and treasurer Bloomsbury Graphite Co., Bloomsbury, N. J., died Sept. 24 at his home in Bloomsbury. The Bloomsbury company was formed by T. T. Hoffman, an uncle of Mr. Wolverton, who succeeded him in charge of production.

Frederick Charles Thomson, manager and treasurer, Michigan Sprocket Chain Co., Detroit, died Sept. 29, at Harper hospital, Detroit, after a short illness. Prior to his association with the Michigan company he was connected with the Michigan Malleable Iron Co., Detroit.

J. Ellis, one of the eight founders of the Institute of British Foundrymen, died recently at an age of 70 years. In 1904, Mr. Ellis and his colleagues, following a meeting in Birmingham, promoted the idea of the institute. He was president of the institute during the year 1916-17. Mr. Ellis started his career as a foundry apprentice.

James Watt Kerr, one of the founders of the Steiger & Kerr Stove & Foundry Co., 2201 Folsom street, San Francisco, died recently. He was 85 years old and had retired from active business about 10 years. He was prominent in civic matters and was chairman of the committee which framed the present charter of the city of San Francisco.

John C. Reed, 83 former plant manager and general superintendent of foundries, Standard Sanitary Mfg. Co., Pittsburgh, died Oct. 1 at his home in that city. Mr. Reed entered the foundry industry in 1883 when he established a jobbing and stove foundry. He began his connection with the Standard Sanitary company ten years later where he rose through many positions. He also was consulting engineer and a member of the board of directors of the company. His son, Henry M. Reed, is first vice president of the Standard company.

Dr. Herbert H. Dow, 64 years old, president, Dow Chemical Co., Midland, Mich., died Oct. 15 at Kahler hospital, Rochester, Minn. He founded the Midland Chemical Co., forerunner of the present concern, in 1890. For many years he was consultant for the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., and in 1917 he was appointed to the advisory committee of the Council for National Defense. Dr. Dow was a member of the American Association for the Advancement of Science, American Chemical Society, American Electrochemical Society, American Institute of Chemical Engineers and Society of Chemical Industries.

W. G. Wallace, chief inspector, American Steel Foundries, Chicago, died recently in that city. He began his affiliation with railroad work in 1874 when he entered the train service of the Chicago & Northwestern railroad. He rose rapidly in the service occupying the positions of engineer, road foreman of engines and general foreman of shops and roundhouse at Clinton, Iowa. He resigned the latter position in 1903 to become superintendent of motive power of the Duluth, Missabe & Northern railroad. He resigned that position in 1907 to take a similar position with the Detroit, Toledo & Ironton railroad. In October of the same year, he entered the employ of the American Steel Foundries as inspector and in 1912 was promoted to chief inspector, a position he held until his recent death.

Gray Iron Has Valuable Engineering Properties

(*Concluded from Page* 88)

ly used in gray iron testing. Results obtained on gray iron with the Herbert pendulum tester are not common in the literature. The recent Vickers hardness tester utilizes the brinell principle, but with a pyramidal diamond indenter pressed into the work under low load and at an automatically controlled rate. It is particularly adapted to testing extremely hard metals and has not been applied widely to testing hardness of gray irons.

The specific gravity or density (reltive to water = 1) of commercial gray irons at room temperatures varies from about 6.95 for open grained high carbon irons to 7.35 for close grained low carbon metals. It has been found that although there is a general approximate correlation between tensile strength and specific gravity, the relationship is far too vague for any hope of prediction of tensility from gravity or vice versa. Gravity usually is an additive function, deducible from the percentages and gravities of the structural components. The specific gravities of the ordinary structural components of gray iron at 15 to 20 degrees Cent. are: Ferrite, 7.85-7.88; graphite, 2.26; cementite, 7.66; pearlite, 7.74; iron phosphide, 6.74; steadite, (about) 7.14; iron sulphide, 5.02, and manganese sulphide, 3.99.

A large amount of graphite due to its low specific gravity makes the metal lighter. Since the differences in gravity between ferrite and pearlite are not great, elements or factors which increase graphitization have a tendency to lower the specific gravity. Further, gray irons high in total carbon normally can be expected to be somewhat lighter than the lower total carbon irons containing a like amount of combined carbon in their makeup.

The specific gravity of manganese sulphide (3.99) being low, this component tends to float in the molten metal. Advantage has been taken of that fact in attempts to lower the sulphur content of the metal. Also when a ladle of molten metal is allowed to stand for some time the top material is richer in sulphur, as can be shown by skimmings removed from the surface. Furthermore, large castings often show higher sulphur on the cope side. Since gas pockets or blowholes normally are found on the cope too, the high sulphur analysis was associated with presence of these defects—a partial explanation of the former fear of higher sulphur irons. From present day experience this seems a not unnatural coincidence.

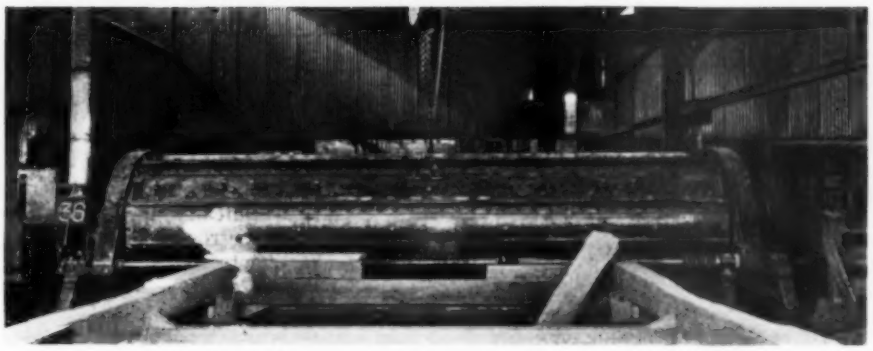
It is well known that the highest strength values are found in irons free from incipient or microscopic shrinkage. Improper feeding (either from faulty gating or too low pouring temperature) causes these microscopic shrinkage cavities. The usual casting has some such internal defect or porosity, even though that may not be serious enough to interfere with its engineering application. Such porosity may be revealed by specific gravity determinations. If the metal has a lower specific gravity than that calculated from its analysis, pouring and molding practice should be investigated and revised to conform to those giving the best results. In hypereutectic gray irons the excess cementite decomposes while the metal still is in a fluid condition. The light graphite resulting floats to the top.

Table VIII gives the specific gravity of five gray irons as determined by Bolton on specimens obtained from different sized test bars. The first two irons are high carbon; the second two are lower carbon irons, and the last is an alloy gray iron containing 1.25 per cent nickel and 0.08 per cent chromium. As may be observed, the higher specific gravity of nickel appears to be reflected in the values for specific gravity. Table IX gives the specific gravity of gray iron as determined by Hailstone, *Carnegie Memoirs*, Iron and Steel institute, 1916. The data shows that there is little variation in the various constituents except in the case of the amounts of graphitic and combined carbons. The variations were secured by casting at decreasing temperatures. Comparison of data by Bolton and Hailstone shows comparable specific gravities where pouring temperatures and analyses are similar.

As may be noted, gray iron is lighter than many cast metals according to specific gravity determinations by S. A. Weigand: He gives the following: Cast bronze (85-5-5-5), 8.53; cast monel, metal, 8.71; cast aluminum bronze, 7.80; and cast steel, 7.84. Moldenke gives the specific gravity of white cast iron as 7.69.

Makes Tumbling Mill

A description of methods of cleaning cast iron pipe at the plant of the McWane Cast Iron Pipe Co., Birmingham, Ala., which appeared in the Oct. 1 issue of THE FOUNDRY, stated "Small pipe in 6-foot lengths and larger sizes in 12-foot lengths are cleaned in a battery of tumbling barrels of the general type shown in Fig. 2, and built by the Whiting Corp., Harvey, Ill." While barrels made by the Whiting Corp. are in use in that plant, the large mill, which was shown as Fig. 2 in the article and is shown in the accompanying illustration, was built by the W. W. Sly Mfg. Co., Cleveland. The mill was designed especially for the McWane company to clean long sections of pipe.



One of the Battery of Long Tumbling Barrels in Which the Pipe Castings Are Cleaned

Dedicates Memorial

(*Concluded from Page* 99)

placed. A littlepond, covered with lily pads, overhung with weeping willows, and encircled by walks, occupies the entrance to the valley.

The outstanding achievements in the life of Mr. Westinghouse may be traced from the panels of the memorial. These include the illumination of the Chicago world's Fair of 1893 by the alternating-current system developed by Mr. Westinghouse; the hydroelectric plant at Niagara Falls with the 5000-horsepower alternating-current electric generators which were supplied by Mr. Westinghouse and were at that time the largest in the world; the steam turbine, introduced into America by Mr. Westinghouse and now used universally for electric generation by steam power; alternating-current railroad electrification, which Mr. Westinghouse advocated and made practicable; the airbrake, the most famous of all Westinghouse inventions; and railroad switching and signaling systems, another of the inventor's contribution to the railroads.

What the Foundries Are Doing

Reflecting the Activities of the Gray Iron, Malleable, Steel and Brass Shops

Rhinelander Iron Co., Rhinelander, Wis., recently was damaged by fire.

Motor Car Ventilator Corp., 424 Washington street, Suffolk, Va., has discontinued business.

F. Earl Landes, Brunnersville, Pa., has purchased the Brunnersville Iron Foundry formerly operated by Frank B. Bentz.

Luzerne Foundry Co., Belleville, Ill., has been incorporated by Simon Schmitt, W. A. Huber and Phil Waigand.

Dayton Malleable Iron Co., Dayton, O., recently suffered a fire damage to its plant to the extent of $300.

Kellam & Monroe Foundry Co., High Point, N. C., recently has changed its name to the Kellam Foundry Co.

Clare Bros. & Co., Preston, Ont., stove manufacturers, are reported considering a plant addition.

Reeve Stove Foundry, Twenty-first and Hays streets, Camden, N. J., recently suffered a fire damage to its plant.

Lynchburg Foundry Co., Lynchburg, Va., is reported to be operating at 100 per cent capacity.

Superior Brass Works Inc., 1737 Lamont avenue, Baltimore, recently increased operations from 2 to 5 days per week.

Board of education, Alliance, O., has plans under consideration for the installation of a foundry in the manual arts department of the high school.

Greenville Steel & Foundry Co., 120 Markly street, Greenville, S. C., has increased its capital from $30,000 to $60,000.

National Transit Pump & Machine Co., Seneca and Central streets, Oil City, Pa., will award the contract for a 2-story foundry. R. Storner is engineer. F. D. Williams is president of the National Co.

National-Erie Co., Fifteenth and Raspberry streets, Erie, Pa., recently installed a new electric furnace in its foundry department.

Miscellaneous sales department, American Steel Foundries, Chicago, has been moved from the main office in Chicago to the Indiana Harbor plant of the company.

Benton Harbor Malleable Industries, Benton Harbor, Mich., will build a new foundry unit 90 x 250 feet. Contract has been awarded to Max W. Stock Construction Co., St. Joseph, Mich.

The gray iron foundry of the Chevrolet Motor Co., Saginaw, Mich., has increased its working time from 7 to 9 hours per day on a 5 day week schedule.

Spring City Foundry Co., Waukesha, Wis., will build a 1-story addition, 100 x 100 feet. Frank D. Chase Inc., 720 North Michigan avenue, Chicago, is receiving bids on separate contracts.

Morel Foundry Co., 533 West Spokane street, Seattle, Wash., has merged with the Schilling Iron & Bronze Co., 1200 Fourth avenue south. The firm specializes in aluminum and bronze work.

Carson Casting Co., 216 Columbia street, Portsmouth, Va., has been organized to operate a jobbing foundry for the production of brass and aluminum castings. J. M. Carson is manager.

Adamson Mfg. Co., East Palestine, O., whose plant recently was severely damaged by fire, will begin the construction soon on a fire-proof structure to replace the damaged building.

Wisconsin Aluminum Foundry Co., South Sixteenth and Franklin streets, Manitowoc, Wis., has been incorporated in Wisconsin with the capital of $250,000. There will be no change in the present ownership or management.

Eastern Malleable Iron Co., Inc., 63 John street, New Britain, Conn., will award a contract for a 2-story plant to be erected at a cost of about $40,000. M. J. Unkelbach, 52 Main street, is the architect.

Taylor-Wharton Iron & Steel Co., High Bridge, N. J., has engaged the National Engineering Co., 549 West Washington boulevard, Chicago, to install a sand handling and reconditioning system in the steel foundry and core room of its High Bridge plant.

Bosshardt Steel Corp., Canton, O., has been incorporated by Ruff & Souers, 1200 Harter Bank building. The company has leased the plant of the Canton Steel Foundry Co. to manufacture automobile and other steel castings.

Canada Iron Foundries, Ltd., 28 Victoria Square, Montreal, Que., has let the contract to W. H. Cooper, 42 James street, north, Montreal, for the erection of a plant at Hamilton, Ont. The construction will be 90 x 140 feet. Cost is estimated at $50,000.

Westman Machine Co., Ltd., formerly Westman Machine Works, Toronto, Ont., has leased space on Ritson road north, Oshawa, Ont., formerly occupied by the McCullough Foundry Co. The company will move from Toronto and establish operations in that plant.

Several plants in Utica, N. Y., report

good business. Richardson & Boynton Co. is working six days a week and is putting on a night shift. Utica Radiator Corp. is working six days, Hart & Crouse Co. five days and the International Heater Co. is reported busy at present.

General Brass Foundry Co. Inc., Chestnut and Coit street, Irvington, N. J., recently organized by Joseph B. Meier and associates, has taken title to property belonging to the Wm. J. Sweet Foundry Co., Newark. The company will manufacture brass, bronze and aluminum castings. (Noted Aug. 15.)

Union Foundry Co., 1910 Grant street, Bellingham, Wash., has been organized to succeed the Union Iron Works. The new firm is composed of John A. Hood, former head of the Union Iron Works, B. M. Wood and George Smith, formerly connected with Lidgerwood Pacific Co., Tacoma, Wash.

Crane Co., 836 South Michigan boulevard, Chicago, has let the contract for replacing its old pipe fabricating shop and foundry at Birmingham, Ala. The company also will increase the capacity of the shop. Estimated cost including an expenditure for a showroom, is approximately $100,000.

John Beckett, Dayton, O., has purchased the foundry department of the Wandtke Pattern & Foundry Co., Ohio avenue, Anderson, Ind., and is building an addition which will double the size of the plant. The concern will be known as the Beckett Bronze Co. and will manufacture brass and aluminum castings.

France Foundry & Machine Co., Toledo, O., operating a gray iron foundry at 1102 Girard street and a nonferrous foundry at 1215 West Bancroft street, has begun the construction of a 2-story, brick, foundry building at 1217 West Bancroft street. The new building will be 32 x 100 feet and contract has been awarded to William Pioch, Toledo.

Increased freight rates on cast iron and related products from Cincinnati, Addyston, Coshocton, Newcomerstown and Jackson to numerous destinations throughout Ohio, which were temporarily suspended July 17, have been permanently suspended by the state utilities commission. The action followed protests by the U. S. Pipe & Foundry Co., Addyston, O., and foundry interests of other states.

Milwaukee Valve Co., 139 South Burrall street, Milwaukee, plans to build several additions and to increase the capacity of other departments. An addition will be erected to its pattern shop and its foundry facilities will be increased for casting bronze, brass and aluminum. Preliminary plans are being made. Construction will begin late in 1930 or early in 1931. John Freser Jr. is president.

Carroll Steel Foundry Co., Houghton, Mich., has started the construction of the main building of its new steel foundry. The building will be 100 x 260 feet of steel and glass construction. Several smaller buildings also will be erected. James R. Carroll is president and general manager, and Richard Carroll, vice president and foundry superintendent. Frederick Noel is secretary and treasurer. (Noted Oct. 15.)

Tucker Foundry Co., Medina, N. Y., has been purchased by the Buffalo Pipe & Foundry Co., Buffalo. The Medina plant will be operated as a branch of the Buffalo corporation which will have its principal production in its Buffalo factory which now is being remodeled for that purpose. Frank B. Baird is president of the Buffalo corporation which acquires a foundry business established nearly 40 years ago and operated continuously since that time.

New Trade Publications

CRANE BRAKE — Electric Controller & Mfg. Co., Cleveland, in a current bulletin presents a brake designed for cranes, featuring simple adjustment and long wear.

ELECTRIC MOTORS — General Electric Co., Schenectady, N. Y., has issued a bulletin on one type of its direct-current electric motors for moderate or heavy duty.

BLOWERS—The P. H. & F. M. Roots Co., Connersville, Ind., division of the Stacey Engineering Co., has issued two, new 4-page bulletins on low pressure and high pressure roller bearing blowers.

LOCK NUTS—Safety Nut Corp., Land Title building, Philadelphia, is distributing a folder which describes a new type of lock nut which it has developed. An illustration of the mechanical features and typical applications is given.

ELEVATOR ENGINES — Warner Elevator Mfg. Co., Cincinnati, has issued a bulletin on its engine for elevator operation. An illustration shows the engine and a full description is presented.

UNIT HEATERS—Buffalo Forge Co., Buffalo, describes the new model unit heaters designated and made by the company for industrial uses. Engineering drawings and dimension tables are given in the folder issued.

CHAIN DRIVES — Link-Belt Co., Indianapolis, has issued a bulletin describing ways to make chain drives last longer. Alignment, adjustment, lubrication, cleaning and proper setup are discussed as they relate to maintaining the life of chain drives.

PORTABLE POWER UNIT—Westinghouse Electric & Mfg. Co., has issued from its works at East Springfield, Mass., a bulletin on a portable power unit designed for use on construction and repair jobs where power is needed.

ELECTRIC FURNACES—The Electric Furnace Co., Salem, O., has issued an illustrated bulletin, describing new gas and electric chain belt conveyor furnaces for heat treating miscellaneous small and medium sized parts and products without pans or trays.

VALVES—Jenkins Bros., 80 White street, New York, has issued an illustrated bulletin which describes Jenkins standard bronze valves with the one-piece, screw-over bonnet and slip-on disk holder. A cross section showing the mechanical construction is included in the bulletin designated as No. 141.

ELECTRIC TOOLS—Standard Electrical Tool Co., Cincinnati, is distributing a new, 8½ x 11-inch, 64-page catalog No. 36 and price list No. 36. A number of new tools are featured and descriptions and illustrations of the complete line of electrical drills, grinders, buffers and polishers are included.

CONTROL EQUIPMENT—General Electric Co., Schenectady, N. Y., has issued a series of bulletins describing control equipment for crane-bridge, crane hoist and trolley motors. Other bulletins describe limit switches, master switches, and thermostats for industrial heating units.

AIR FILTERS—An 8-page illustrated bulletin, No. 120, issued by the American Air Filter Co., Inc., Louisville, Ky., presents a description of the air filters made for compressors, and internal combustion engines. Technical data is given covering construction, application and capacity.

REFRACTORIES—A booklet on its ramming mixture for monolithic furnace construction and repair has been issued by the Charles Taylor Sons Co., Cincinnati. It is applicable especially in oil and gas fired furnaces used in melting brass, aluminum and special alloys.

TRAMRAIL—In a current bulletin Cleveland Electric Tramrail division of the Cleveland Crane & Engineering Co., Wickliffe, O., suggests increasing capacity of present oven equipment by use of tramrail rack carriers. Illustrations show installations which have given this result.

HANDLING EQUIPMENT — Barrett-Cravens Co., Chicago, is distributing a booklet illustrating and describing its new line of lift-trucks. A brief description of material platforms, portable elevators, steel storage racks and barrel trucks also is included with the numbers of company bulletins describing these products.

OVENS—Gehnrich Oven Co. Inc., Long Island City, N. Y., has issued a booklet outlining the construction, design and features of the various industrial ovens the company manufactures. Eight sections cover construction features, industrial gas ovens, industrial electric ovens, representative installations, foundry ovens, industrial air heaters, dual panel and oven trucks, and trays.

FLEXIBLE COUPLINGS — Westinghouse Electric & Mfg. Co., Nuttall Works, Pittsburgh, has issued a bulletin on its flexible couplings of various types for steel mill machinery. The several types are illustrated and data are given to guide in selection of the proper coupling for a given installation. Another bulletin from the same source relates to speed reducers, containing descriptions and illustrations of the reducers and applications to various uses.

LIGHT REFLECTION—New Jersey Zinc Co., 160 Front street, New York, is distributing an illustrated booklet on the light reflection value of colors in paint. The costs of lighting, emotional effects of colors, the reflection value of tints and working efficiency under various light conditions are some of the topics discussed. A color chart is included showing the reflection values of paint colors and the acceleration of reflecting value as tints become lighter in color.